

ECONOMIC PERFORMANCE ANALYSIS OF KANSAS COOPERATIVE
FARM SUPPLY SALES EXEMPLIFIED BY TBA ITEMS

by

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TABLE OF CONTENTS

	page
LIST OF TABLES	iv
LIST OF FIGURES	vi
INTRODUCTION	1
PROBLEM	3
OBJECTIVES	3
REVIEW OF LITERATURE	3
SCOPE	10
METHOD AND DATA	12
THE SAMPLE	16
ANALYSIS OF TIRE AND TUBE DEPARTMENT	18
Accounting Results	19
Regression Analysis	19
Ratio Analysis	27
Revenue ratios	28
Expense ratios	32
Inventory ratios	42
Break-Even Point Analysis	52
Example of Analysis	60
ANALYSIS OF BATTERY DEPARTMENT	66
Regression Analysis	66
Accounting Results	70
Ratio Analysis	72
Revenue ratios	72
Expense ratios	75
Inventory ratios	81
Break-Even Point Analysis	86
Example of Analysis	94
SUMMARY AND CONCLUSIONS	100
ACKNOWLEDGMENTS	104
LITERATURE CITED	105

LIST OF TABLES

table	page
1. Tire and Tube: Dollar performance of firms in sample.	20
2. Tire and Tube: Net margin regression analysis results.	22
3. Tire and Tube: Gross margin regression analysis results.	25
4. Tire and Tube: Revenue ratios, gross and net margin expressed as a percent of net sales and on a per unit basis.	29
5. Tire and Tube: Expense groupings and total expenses expressed as percentages of net sales.	34
6. Tire and Tube: Expense groupings and total expenses expressed as percentages of gross margin.	38
7. Tire and Tube: Individual expense items as a percentage of total expense.	40
8. Tire and Tube: Average inventory turnover and inventory value.	44
9. Tire and Tube: Desired minimum ITO and maximum inventory level given current sales volume and example rates of return on investment.	48
10. Tire and Tube: Actual and possible break-even point and derivation.	54
11. Tire and Tube: Ratios and results for firms 6 and 1 presented for analysis of total performance.	61
12. Battery: Net margin regression analysis results.	67
13. Battery: Gross margin regression analysis results.	69
14. Battery: Dollar performance of firms in sample.	71
15. Battery: Revenue ratios, gross and net margin expressed as a percent of net sales and on a per unit basis.	73
16. Battery: Expense groupings and total expenses expressed as percentages of net sales.	76
17. Battery: Expense groupings and total expenses expressed as percentages of gross margin.	77

LIST OF TABLES
(continued)

table	page
18. Battery: Individual expense items as a percentage of total expense.	80
19. Battery: Average inventory turnover and inventory value.	83
20. Battery: Desired minimum ITO and maximum inventory level given current sales volume and example rates of return on investment.	85
21. Battery: Actual and possible break-even point and derivation.	87
22. Battery: Ratios and results for firms 7 and 11 presented for analysis of total performance.	95

LIST OF FIGURES

figure	page
1. Data Collection Form	14
2. Tire and Tube: Sample average actual and possible BEP.	56
3. Tire and Tube: Firms 13 and 7 - break-even charts illustrating effects of variation in expenses and average cost.	58
4. Battery: Sample average actual and possible BEP.	90
5. Battery: Firms 9 and 15 - break-even charts illustrating effects of variation in expenses and average cost.	92

INTRODUCTION

In many small and medium sized towns in Kansas, the farmers cooperative association serves as a prime source of farm supplies for the surrounding farm and community populace. These associations also provide the major outlet for marketable farm products at the local level. They often represent the largest business in the community and provide local employment and other community revenue through taxes, gifts, and so forth.

The past has seen the cooperative association thriving on the handling, storage, and sale of grains. In many cases, farm supplies were regarded as sidelines under the heading of service to patrons. As such, this area of the business obtained insufficient attention and simply rode along on the profitableness of grain marketing.

If the major objectives of the cooperative regarding farm supply are: (1) to sell competitively, and (2) to then return any net savings to the patrons in the form of patronage refunds or stock dividends, then farm supplies cannot be economically neglected. Even assuming that farm supply is entirely a service gives no justification to the practice of using patron and member savings from grain marketing activities to cover losses in the farm supply activity.

Within the past 15 years, certain trends have forced cooperative management to take a hard look at the farm supply end of the business. Manuel found that the average grain sales for 50 Kansas grain associations had increased from \$393,948 in 1950 to \$489,072 in 1960, a 24.1 percent increase. Comparatively, farm supply sales, averaging \$126,682 in 1950, were \$237,447 in 1960. This represented an increase of 87.4 percent.¹

¹Milton L. Manuel, A Decade of Farmer Cooperatives in Kansas, Kansas State Agricultural Experiment Station, Bulletin 450, December 1962, p. 17.

Perhaps net sales should not be the gauge of performance. Manuel found average gross operating income from grain sales of \$17,671 in 1950 and \$17,686 in 1960, about one tenth of one percent increase. In the same decade, average gross operating income from sale of supplies increased 87.9 percent from \$19,297 to \$36,268.²

The performance gauge which has the largest effect on the member and patron is the net operating savings. Manuel found a change in grain margins from 4.5 percent to 3.6 percent, a 20 percent decrease over the decade. Supply margins remained nearly the same at 15.2 percent in 1950 and 15.3 percent in 1960 on the average.³

Grain sales are becoming less profitable and more recently benefits from storage have decreased also. "Commodity Credit Corporation grain stored in approved Kansas commercial storage facilities has decreased from 67 percent of capacity on March 31, 1962 to 36 percent of capacity on December 31, 1964."⁴

The sale of farm supply items is becoming an increasingly larger portion of the cooperative's business. For purposes of survival, the cooperative association must be certain that supplies pay their own way.

²Ibid, p. 16.

³Ibid, p. 17.

⁴Letter from Mr. Carl M. Heaton, Acting Director, Agricultural Stabilization and Conservation Service, United States Department of Agriculture, Kansas City, Missouri, April 14, 1965, cited by Richard Lee Epard, "An Economic Analysis of Factors Affecting Success of Kansas Grain Cooperatives, 1963-64," (unpublished Master's thesis, Department of Economics, Kansas State University, 1965) p. 3.

PROBLEM -

Several questions arise when the situation is considered. If the supply activity was considered simply as a service, can the lack of profitability be attributed to pricing practices or to some other variable? If the associations were attempting to price competitively in their local markets, then there is doubt that pricing practice changes, particularly increases, could improve the situation. The search should then be directed to other practices. The problem of primary importance is to determine whether or not a particular economic activity is paying for itself and, if not, then why not. Corrective action can proceed only after the source of difficulty has been ascertained.

OBJECTIVES

The objectives of this study are: (1) to investigate the possibility of departmentalized analysis of supply sales given the current record keeping procedures of local cooperatives, and determine if revisions are needed in these procedures; (2) to investigate the implications of inventory procedures and expense control on sales operations and performance, using (a) tires and tubes, and (b) batteries as the members of sample departments; (3) to determine if some other variables have an effect on the success of the department and to investigate the amount of their influence; (4) to suggest and apply methods of analyzing selling performance which are sufficiently general to be used in other farm supply departments.

REVIEW OF LITERATURE

One of the more popular methods used to provide information for managerial decision making is ratio analysis.

Schermerborn⁵ indicates the usefulness of several ratios. Two of the operating ratios commonly used are (net) operating profit as a percentage of net sales and gross profit as a percentage of net sales. (In cooperatives, a substitution of the word "savings" for the word "profit" is in order but this would not alter the ratios.) He contends that the principle uses of these ratios are 1) to compare internal performance over time, and 2) to compare current operations with similar businesses. Also, changes in the firm's efficiency over time will be indicated by the ratios of expense items to net sales.

Others have advanced the idea that ratios based on year-end financial statements of the entire business may not furnish the optimum amount of information. Epard states:

Associations now, more than ever, need to know how much a particular product contributes to the success of the total business operations.⁶
.....

Of the three types of departmentation presented (by function, product, or location), the one which can provide the manager with the most valuable information is departmentation by product. Accounting records should be kept showing revenue, physical volumes, and costs of each major product or service offered by the association.⁷

Vance⁸ indicated several forms in which data for managerial decisions on sales might be maintained. These included: 1) the "distribution" of

⁵Richard W. Schermerborn, Financial Statement Analysis for Agricultural Marketing Firms, Cooperative Extension Service, Agricultural Economics Information Series, Number 24, February 1964, p. 26.

⁶Richard Lee Epard, "An Economic Analysis of Factors Affecting Success of Kansas Grain Cooperatives, 1963-64," (unpublished Master's thesis, Department of Economics, Kansas State University, 1965) p. 4.

⁷Ibid, p. 12.

⁸Lawrence L. Vance, "Essential Records and Accounting Controls," Managing the Independent Business, Edited by Lee E. Preston (Englewood Cliffs, N. J.: Prentice Hall, Inc., 1962) p. 50.

sales revenue, by departments, territories, class of consumer, or other, with the possibility of separating expenses in the same classes; 2) the "contribution" of the product or product line defined as "the amount provided by the sales revenue over and above the expenses caused by selling that particular product or line..."; and, 3) the "inventory turnover" which helps to identify unprofitable lines.

Several empirical studies have been undertaken and results obtained concerning these ratios. Epard⁹ found that the average ratio of gross margin to sales for 64 Kansas cooperatives was 15.2 percent for all supply sales. He also found that the average ratio of "Total operating savings" to "Sales plus other operating income" was 2.3¹⁰ percent.

Schaars¹¹ found that, for 640 local farm supply cooperatives in twelve Central and Western States, the median savings equaled 5.1 percent of sales. The majority of the associations had ratios between 2 and 7 percent of sales. This study used data for 1962 and 1963.

Average net savings to sales of 1.5 percent for 27 Ohio elevator and farm supply organizations was computed by Burkes and Henning.¹² They also determined the ratio of total expenses to net sales to be 12.1 percent. Both ratios were based on 1960 data.

⁹Epard, op. cit. p. 27.

¹⁰Epard, op. cit. p. 45.

¹¹Marvin A. Schaars, Local Cooperative Farm Supply Association: Their Volume and Net Savings, University of Wisconsin, Department of Agricultural Economics, Ag. Ec. 42, January 1965, p. 3.

¹²Marshall R. Burkes and George F. Henning, Ratio Analysis Used to Measure Financial Strength of Agricultural Business Corporations, Wooster, Ohio, Ohio Agricultural Experiment Station, A.E. 340, November 1963, p. 5.

Taylor¹³ worked with 1952-53 data for 149 midwestern petroleum associations. The average net savings for these firms was 2.82 percent of sales. Total expenses ranged from 6.45 to 28.96¹⁴ percent of sales with the mode falling within the 15-17.9 percent class. Gross margin ranged from 9.23 to 26.83¹⁵ percent of sales with the mode falling in the 15-16.9 percent class.

Milner¹⁶ investigated expense control in 138 elevator and farm supply organizations in Ohio. He expressed various expense classifications as a proportion of total expense. Using 1956-57 data, he obtained these averages showing the makeup of the major expense items: salaries and wages - .54; depreciation - .11; and the various other items combined - .35.

Epard¹⁷ computed several expense categories in relation to gross operating margin. He found that total expenses averaged 82.7 percent of gross operating margin. Salaries and wages, including employee benefit and health programs, averaged 39.5 percent; other out-of-pocket costs - 29.4 percent and depreciation - 13.8 percent.

Manuel¹⁸ summarized 1955-56 data on 50 cooperative petroleum

¹³Byron Eugene Taylor, "Analysis of Economic Factors Affecting Success of Operations of Selected Midwestern Petroleum Cooperatives," (unpublished Master's thesis, Department of Agricultural Economics, Kansas State University, 1958) pp. 11-12.

¹⁴Ibid, pp. 37-38.

¹⁵Ibid, pp. 34-35.

¹⁶Ross Milner, How to Control Expenses at Country Elevators, Ohio State University, Agricultural Extension Service, MM-166, n.d., pp. 6-7.

¹⁷Epard, op. cit., p. 24.

¹⁸Milton L. Manuel, Financial Summaries and Analysis: Co-ops in Kansas, Manhattan, Kansas, Agricultural Experiment Station Circular 361, July 1958, p. 12.

associations in Kansas. The ratios of expense items to total gross margin found were: total expense - 76.3 percent; salaries and wages - 48.2 percent; depreciation - 5.6 percent; insurance - 2.4 percent; advertising and education - 1.8 percent; and interest expense - 0.9 percent. He also determined the average gross margin on tire and tube sales to be 19.9¹⁹ percent of sales.

In another study of 50 Kansas cooperative grain associations, Manuel²⁰ reported net operating savings of 4.2 cents for each one dollar of gross operating income on the average for 1960 data. By the same gauge, salaries and wages required 22.8 cents and total expenses took 57.5 cents.

Another useful ratio for managerial decisions is the inventory turnover, commonly computed as the cost of goods sold divided by the average inventory value. Schermerborn²¹ indicates that the significance of this ratio is its assistance in judging the salability of the inventory and the length of time needed to convert it to cash.

Vance²² lists several recording methods for inventory control. They are: 1) "Perpetual inventory method," with an account for each item showing units received, sold, and on hand, and including associated cost figures; 2) "Retail inventory method," showing beginning inventory, purchases, and sales, all at sale prices, and checked by a physical count; 3) "Physical inventory method," which is perhaps a lack of method but is least expensive. He suggests that the first method is the optimum one for managerial decisions.

¹⁹Ibid, p. 11.

²⁰Manuel, A Decade . . ., op. cit., p. 17.

²¹Schermerborn, op. cit., p. 28.

²²Vance, op. cit., pp. 52-53.

Eichers²³ reported the results of a study of 12 associations in Kansas and Nebraska selected because they exhibited superior credit control and, hopefully, better than average inventory management. TBA²⁴ items accounted for 8 to 31 percent of total inventory value and averaged 18 percent. The average inventory value was \$53,301. Representative average inventory turnover ratios²⁵ were: petroleum - 19.0 times per year; TBA items - 2.8 times per year, ranging from 1.4 to 5.0; and the average of all farm supply - 8.0 times per year.

The costs of maintaining inventories can become burdensome. Eichers states:

Inventory costs are closely related to inventory size and turnover. These costs include interest, insurance, taxes, shrinkage, and obsolescence. According to several authorities these may easily amount to 10 percent of the average inventories on hand each year.

At this rate inventory costs would amount to \$28 for 1 day's supply of inventory or \$140 for 5 days' supply if sales amounted to \$100,000 per year. Or stated in another way, reducing the supply of inventory by only 5 days will result in yearly savings of \$140 in an association with \$100,000 sales.²⁶

When the firm has 5 days supply in inventory, this is equivalent to an inventory turnover of 72 times per year. If inventory turnover were 4 times per year, then that represents 90 days supply and, at Eichers rate, \$2,520²⁷ of inventory cost would be incurred for \$100,000 of annual sales.

²³Theodore R. Eichers, Inventory Management by Selected Retail Farm Supply Co-ops, Area IV, Farmer Cooperative Service, United States Department of Agriculture, General Report 66, October 1959, p. 2.

²⁴Ibid., p. 10, TBA stands for "Tires, Batteries, and Accessories.

²⁵Ibid., p. 13.

²⁶Ibid., p. 14.

²⁷Ibid., p. 17.

Epard²⁸ reported inventory turnover rates for 64 Kansas cooperatives. The average for gasoline was 26.6 times per year; for tires and tubes, 1.8 times per year; and for all supply items, 6.2 times per year.

Vance²⁹ suggests the usefulness of another tool, the break-even point. This tool makes use of the distinction between fixed and variable costs. With average variable costs and average fixed costs computed as a percentage of sales, the break-even point in terms of sales dollars can be computed by dividing the fixed cost percentage by the fraction: one minus the variable cost percentage divided by the sales percentage (100 percent). This method can be used to determine the required sales volume for a desired net savings by simply adding that net savings rate to the fixed cost. It is also useful in making pricing decisions.

A tool which can be used to analyze the quantitative effect of one or more variables on some particular variable is linear multiple regression. Epard³⁰ obtained a regression equation using as X_1 (the dependent variable), net operating savings. He considered the effects of two variables on X_1 . They are: X_2 , the inventory turnover in tenths of one turnover; and X_3 , the average gross margin in dollars. The equation is:

$$X_1 = -2,923.572 + 22.745X_2 + 0.329X_3.$$

He concluded, "This analysis indicates that on the average net operating savings changes \$22.75 for every 0.1 change in inventory turnover and 32.9 cents for every \$1.00 change in gross margins."³¹

The author's study is an attempt to apply the above methods to

²⁸Epard, op. cit., p. 29.

²⁹Vance, op. cit., p. 62.

³⁰Epard, op. cit., p. 30.

³¹Epard, op. cit.

original data and to make necessary adaptations which can be more beneficial as aids to managerial decision making.

SCOPE

A prime objective of this study was to investigate the use of managerial accounting methods by product departments. This has been done to some extent on a yearly basis, and is used by the cooperative auditing services in Kansas. Epard stated:

Accounting information is of little benefit to managers if statements of departmental operations are prepared on only an annual basis. Statements should be made monthly if a manager is to derive maximum benefit from accounting records.³²

The procedures could be more meaningful if the information were available on a monthly basis so the objective was qualified in this manner. A secondary objective was to attempt to obtain and use data in terms of units as well as dollars since this could allow a more thorough analysis. The problem of seasonality also needed to be considered since it causes serious difficulties of intra-firm comparisons when the information is tabulated from monthly data. Due to the fact that experience with the accounting records of local cooperatives was slight, it was decided that the product line to be studied should be merchandised without alteration of its physical form. The experience gained with the study should then aid in determining whether processing costs could be ascertained from the existing accounting records.

The scope of the study was delineated as a product or product line having the following characteristics:

³²Epard, op. cit., pp. 12-13.

1. a relatively small number of units so that sales and inventory could be counted if necessary,
2. a relatively low seasonality,
3. all units are merchandised without processing, and
4. a large enough proportion of sales to be feasibly considered as a separate department.

The product line of tires, tubes and batteries is not processed. The number of units sold by a local cooperative during one month is readily countable. Evidence concerning the size of the sales of this line was found in previous empirical work.

Eichers³³ found that 12 associations in Kansas and Nebraska had TBA sales ranging from 2 to 12 percent of total sales and averaging 6 percent. The average sales per association was \$378,210. Thus, TBA sales averaged 6 percent of \$378,210 which equals \$42,693 per year.

Epard³⁴ reported on average of 0.6 percent of sales being tires and tubes in 64 Kansas grain associations. With average sales of \$1,470,960, the average tire and tube sales were \$8,826 per year in firms having average farm supply sales of 39.9 percent of total sales.

The results shown above confirmed the opinion that TBA sales could be considered for departmental analysis. Some seasonality exists in the sales of tires and tubes. Discussions with fieldmen from the regional supply cooperative in Eastern Kansas along with conversation with local cooperative managers revealed that tire and tube sales have peak volume periods during mid-summer and late fall. The various persons agreed that

³³Eichers, op. cit., p. 3.

³⁴Epard, op. cit., p. 25.

the sales during August of a given year would approximate an average month.

Thus, the scope of the study became an analysis of the sales efforts behind the August 1965 sales of tires, tubes, and batteries. The data would be determined from current accounting or record keeping procedures of a representative sample of Kansas farm supply cooperatives.

METHOD AND DATA

Tires, tubes, and batteries are available on a wide range of size and type. The type generally refers to the quality and indirectly to the selling price of the tire. For instance, the custom hi-level tire is the highest quality, and by size comparison, the highest priced passenger tire carried by the local cooperative. This is general over much of Kansas since a regional supply cooperative acts in the capacity of wholesaler for most of the locals. The regional lists over 400 different tires, tubes, and batteries and the majority of them are sold to the local cooperative at different prices.

When counting units, a passenger tire and a rear tractor tire are not comparable. To overcome the size and type problem, a method of equivalency was used. This is roughly analogous to the more common use of index numbers. The custom hi-level whitewall 800-14 was used as one tire and tube equivalent. The choice was based on the fact that this class contained the greatest number of units sold in August. The battery used as one equivalent was selected for the same reason. Then, using the wholesale price list, each tire and tube was expressed as being equal to the ratio of its own price to the price of the equivalent. The equivalent listed at \$21.70. Thus, if a boat trailer tire listed at \$10.85, it would be considered 0.5

equivalents whereas a tractor tire at \$86.80 would be 4.0 equivalents. Figure 1 shows a portion to the worksheet used by the author while obtaining the data. The appropriate equivalent ratios have been superimposed in the total revenue column. Following collection of the data, various size and type categories having the same cost (and equivalent ratio) were combined with the result that 242 ratios were needed for tires and tubes. The batteries were reduced to 18 various ratios.

Sales and inventory data were obtained by physical number. Information regarding cash discounts allowed by the locals and total deviations from the price listed in the "1965 Spring-Summer Catalog" published by the regional was obtained. The individual expense items were taken from the available source. If an annual audit including the month of August 1965 was completed, then a month's total expense was determined by dividing the total expense by 12. If it was not available, then the expenses were taken from the general ledger and averaged for the number of months available. The total sales of the firm, as well as the sales of the service station if grain, feed, or fertilizer was handled, was also obtained in terms of dollars. This proved to be sufficient data to make the analysis.

For purposes of the analysis, it was assumed that excise tax on these items was simply passed on to the final consumer. Therefore, it need have no influence on the firm's operation and could be eliminated.

Reference to a tire unit after this will mean one tire and tube equivalent which appears on the wholesale price list at \$21.70 and has a retail list price of \$26.85 (Figure 1, the "sell price" includes excise tax). Reference to a battery unit will indicate one battery equivalent which is represented by the co-op heavy duty 24 which the local purchases for \$20.60 and lists to sell for \$25.75.

Firm	XYZ	Subject	Tires, Cars	Period	August, 1985								
Item	Q Sold	Sell Price	Total Sales	disc # / %	Total Adj	Total Cash	Buy Price	Total Cost	disc % / \$	Et/ tire	Total ET	Total Cost	Invnt
001 HLW/b 600-13		21.28					75.22	15.95		1.58			
002 640/650-13		22.74					86.84	17.40		1.79			
003 700-13		23.66					83.79	17.95		1.96			
004 650-14		23.68					83.80	18.05		1.93			
005 700-14		25.13					86.06	18.75		2.08			
006 750-14		26.34					51.24	19.80		2.19			
007 800-14		29.22					1.66	21.70		2.37			
008 850-14		31.31					1.67	23.85		2.56			
009 900/950-14		36.09					1.26	27.45		2.99			
010 600-15		23.72					83.80	18.05		1.87			
011 640/650-15		25.10					86.46	18.75		2.05			
012 670-15		26.54					41.24	19.80		2.19			
013 710-15		29.17					1.66	21.70		2.32			
014 760-15		31.28					1.67	23.85		2.53			
015 800/820-15		35.84					1.26	27.45		2.74			
016 710-15/6		18.33					1.23	26.65		2.58			
017 HL b 600-13		21.14					64.77	14.10		1.58			
018 640/650-13		20.91					76.67	15.30		1.79			
019 700-13		20.91					72.81	15.80		1.96			
020 650-14		22.08					73.92	15.95		1.93			
021 700-14		22.03					76.26	16.55		2.08			
022 750-14		23.44					82.45	17.50		2.19			
023 800-14		25.67					83.24	19.15		2.37			
024 850-14		27.51					1.67	21.00		2.56			
025 900/950-14		31.79					1.67	23.85		2.99			
026 600-15		20.77					1.21	25.65		1.87			

Figure 1.--Data Collection Form.

The data collected were converted to tire units and battery units. These were then multiplied by the respective selling list prices and total sales of used tires and batteries were included to determine each firm's total possible revenue from sales. Selling discounts and the net adjustments were then deducted to determine net sales for the month for each cooperative. The net adjustments for a firm are defined as the total deviation from catalog list price minus the total credit received on damaged tires.

The regional offers various quantity discounts on purchases. A weighted average discount on all tires and tubes was computed as 11.21 percent. This figure multiplied by the average proportion of discounts taken, as estimated by each local manager, gave the average percentage discount realized by each association. This was deducted from the total list cost to determine net cost of goods sold per unit.

Expense data were obtained including all direct expenses to the station and a proportion of administrative expenses. This proportion was determined by dividing station sales by the total sales. The expenses were averaged for one month as were station sales. It was then assumed that the activity of selling tires and tubes should be charged with the same proportion of station expenses as their own sales were of the station sales. A proportion of the expenses was allocated to batteries in the same manner. It is unfortunate that a more accurate allocation was not available but the expense to be incurred by the local cooperative in obtaining it might outweigh the benefit. The present method is sufficient for the analysis.

Given these data, the gross operating savings for each firm was computed by deducting the net cost of goods sold from the net sales, and net

operating savings by deducting the total expenses (including an imputed inventory cost) from that remainder. These figures, and the individual expense items, were used to obtain the results of the ratio analysis.

The revenue, cost, and savings data, along with several expense groupings and the total inventory value were reduced to a unit basis by dividing each by the individual firm's number of units sold. Variation due to sales volume is then ruled out and the absolute figures are more comparable. These data were analyzed by inspection and by linear multiple regression.

For purposes of the break-even point (BEP) analysis, it was assumed that the expenses for the station would not change even if the level of sales of tires, tubes, and batteries were varied greatly. Thus, the amount of expenses allocated to batteries could be treated as if it were the associated fixed cost. The variable cost per unit would then be the net cost of goods sold per unit.

The above process was performed on tire and tube sales and on battery sales. The results were also analyzed by comparing the half of the firms with higher net sales of tires and tubes to the half with lower net sales. This was done also with batteries and serves as an additional check of the effect of sales volume on tire sales.

THE SAMPLE

Limits of time and interview scheduling problems of the author dictated that the sample be taken from a population located within two hours driving time (about 120 miles) from the Kansas State University. A list was obtained of the local cooperatives within the distance requirements handling TBA items. This list contained 62 cooperative sales locations.

It was decided that a random sample of one third of these accounts could be handled within the time limits and would represent an accurate cross section of the population.

In all of the cooperatives in the sample, it was necessary to refer to the sales tickets to obtain the sales information by size and type. This information was not available even on sales tickets for three of the 21 firms. Therefore, the analysis was performed on 18 cooperatives.

ANALYSIS OF TIRE AND TUBE DEPARTMENT

The analytical tools used in the study can be classified under three headings. The first, regression analysis, views the interrelationships of selected variables. The object is to determine the extent to which the variation in a selected "dependent" variable is consistent with, and therefore "explained" by, the variation in one or more "independent" variables. The results present both the magnitude and relative strength of the observed interrelations. A second class of tools, ratios, perform several functions. An interfirm comparison when wide variations in sales volume exist is possible only with ratios. In addition, the revenue ratios indicate the existence of problems in a firm's performance and aid in delineation of the problem area. Expense ratios are used to locate the source of difficulty when it occurs in the area between gross and net margin. Inventory ratios provide an examination in depth of the implicit expense of carrying inventory and reinforce hypotheses concerning problem sources in the performance area between sales and gross margin. The third tool classification, break-even point analysis, presents a graphic view of the overall performance of a firm or department and stresses the interrelationships among the variables. The overall effects of changes in the variables can be readily observed and comprehended through its use.

The analysis of the tire and tube department will begin with a presentation of abbreviated operating statements for the 18 departments during the month of August, 1965. The analysis must be based on the knowledge of the relative and absolute size of the department. The results and implications of the use of the tools will be presented along with the general conclusions for the sample. The section will be concluded with the

individual analysis of two of the firms, thereby providing examples of the use of the suggested procedure.

Accounting Results

Results for tire and tube departments of the 18 firms are shown in Table 1. Net sales ranged from \$214.97 to \$5,056.04 for the month. Deducting the cost of goods sold (not tabled) left the total gross margin for each firm. The 18 firms averaged gross margin of \$370.99, out of net sales of \$1,543.55, to cover expenses and provide a return on operations. Each firm's expenses were then deducted from the respective gross margin to yield net margin. The average firm incurred \$336.07 in expenses leaving a net margin of \$34.92. Over the sample, the net margin ranged from a loss of \$492.57 to a net saving of \$1,030.64.

Station sales in the study were defined as the sales of the association's service station as a separate division. In several cases, it was the sole economic activity of the enterprise. The majority of the firms also handled grains and many merchandized other items. The net sales of the tire and tube (T & T) department were expressed as a percent of the total sales of the service station "division" to indicate the relative importance of the department. The average of the 18 firms was 11.8 percent. The department ranged from 0.3 to 38.0 percent of station sales for the month. The department is large enough to cause serious difficulties for the firm if neglected.

Regression Analysis

The use of regression analysis on cross-sectional data required the assumption that different values of a variable from firm to firm can be

Table 1.--Tire and Tube: Dollar performance of firms in sample.

Firm Number	Net sales		Gross margin	Expenses	Net margin
	percent ^a	total			
1	7.9	\$ 657.72	\$ 155.30	\$ 94.10	\$ 61.20
2	38.0	2,214.52	553.21	1,030.64	- 477.43
3	8.5	5,056.04	1,522.83	504.69	1,018.14
4	8.5	2,158.94	265.90	328.81	- 62.92
5	5.9	3,800.34	1,172.44	798.68	373.75
6	8.3	1,654.83	276.30	768.87	- 492.57
7	5.1	267.99	74.65	109.14	- 34.49
8	28.7	778.93	241.62	390.61	- 149.00
9	0.7	333.70	38.60	58.83	- 20.23
10	4.3	1,776.21	274.99	56.76	218.23
11	11.5	543.06	201.00	212.60	- 11.60
12	11.5	1,243.48	238.73	151.58	87.15
13	0.3	214.97	40.02	23.99	16.03
14	12.5	2,349.59	468.75	362.29	106.46
15	26.9	472.23	123.46	356.87	- 233.41
16	4.2	1,404.88	358.53	303.57	54.97
17	2.8	1,666.08	352.77	198.11	154.66
18	27.0	1,190.37	318.78	299.17	19.61
Range: High	38.0	5,056.04	1,522.83	1,030.64	1,018.14
Low	0.3	214.97	38.60	23.99	- 492.57
Average of 18	11.8 ^b	1,543.55 ^b	370.99 ^b	336.07 ^b	34.92 ^b

^aNet sales as a percent of total station sales.^bSimple average.

Source: Original Data.

construed to be identical with changes of that variable. It is conceivable that differences due to sales volume variation could negate this assumption. For this reason, the variables having the common denominator of dollars were expressed on a basis of dollars per unit sold.

The process of regression analysis attempts to place actual numerical values upon the effect on the dependent variable of the various independent variables. It also offers a method by which to determine how much of the variation in the dependent variable is "explained" by changes in the independent variables separately and as a group. Thus, it can help to show what variables should be concentrated upon in order to obtain a favorable response from the dependent variable.

The choice of the dependent variable is determined by the information being sought. The analytical procedure does not directly indicate whether the chosen dependent variable is actually dependent upon the set of independent variables. Improper selection can lead to false results. However, a high multiple correlation coefficient does indicate that the regression coefficients will not differ substantially if some of the less significant variables are deleted or replaced. A formula using net margin per unit as the dependent variable, and the six other variables listed in Table 2 as the independent variables, proved to have a multiple correlation coefficient of 0.978.

In regression analysis, the regression coefficient expresses the observed relation between the variations of the dependent variable and those of the respective independent variable while all other variables are held constant at their mean values. The standard statistical t-test was applied to the coefficients to determine if each was significantly different from zero. A process of standardization was also applied to investigate the

Table 2.--Tire and Tube: Net margin regression analysis results.

Variable	: Regression : coefficient	: Standard : error	: Standardized : coefficient	: Sample : t-value
X ₂ - Gross margin/unit	0.722	0.433	0.394	1.783 ²
X ₃ - Average price/unit	-0.177	0.437	-0.082	- 0.404
X ₄ - Adjustment/unit	-0.071	0.225	-0.023	- 0.314
X ₅ - "Human" expense/unit	-1.265	0.115	-0.961	-10.989 ¹
X ₆ - Inventory level/unit	-0.004	0.003	-0.112	- 1.130 ³
X ₇ - ITO (times per month)	0.318	2.681	0.012	0.119
.....
Constant term = 4.50	:	R = 0.978	:	d.f. = 11

¹Significant at 0.01 level.

²Significant at 0.1 level.

³Significant at 0.3 level.

Source: Original Data.

relative strength of the relationships. The latter process adjusts the coefficients so as to cause each to have a standard error equal to one. The results are shown in Table 2 as the "standardized coefficients."

The negative or inverse relationship between net margin and "human" expense is the strongest in the equation. In other words, variations in "human" expense were observed to have the greatest "influence," of the variables used, upon variations in net margin. The second largest coefficient was the .394 associated with gross margin. Thus, X₂ varied directly with net margin and was ranked second in its ability to "explain" variations in net margin. The third ranked variable was the inventory level. Here the relationship was inverse with a coefficient of -.112.

The regression coefficients before standardization can be statistically tested to determine if they are significantly different from zero with a given degree of probability. Economic studies commonly use the 0.05 level

of significance. If the sample t-value is larger than the appropriate value in the table used for the t-test, the interpretation is that, on the average, this result would occur only 5 times out of 100 attempts if the true population coefficient were zero. To obtain more accuracy, the level of significance was varied. The sample t-value of -10.989 for "human" expense was significant at the 0.01 level with the equation's 11 degrees of freedom. On the average, there existed a 1 in 100 chance that the coefficient was actually zero and random disturbances caused the coefficient to be this size. Since the appropriate value in the t-table was ± 3.106 , it was suspected that the chance factor is even smaller. The sample t-value of 1.783 for gross margin was significant at the 0.1 level, and the -1.13 for inventory level was significant at the 0.3 level. Therefore, it is not possible to place much confidence in the regression coefficient found for inventory level. On the average, this value could occur 3 times in 10 even though the true value of the population coefficient might be zero.

Using " X_1 " to denote net margin, the regression coefficients in Table 2 can be expressed in an equation which enhances the notion of interdependence of the variables. The equation is:

$$X_1 = 4.5 + 0.77X_2 - 0.18X_3 - 0.07X_4 - 1.27X_5 - 0.0039X_6 + 0.32X_7.$$

The coefficient of X_5 , "human" expense, is -1.27. This indicates that, for the sample data, a 1 percent change in the level of "human" expense was associated with a 1.27 percent change in net margin in the opposite direction. That is, a \$1.00 decrease in "human" expense was accompanied by a \$1.27 increase in net margin. The relationship holds with the directions reversed.

The coefficient of 0.77 for X_2 indicates that a 1 percent change in gross margin was found to occur in conjunction with a 0.77 percent change

in net margin in the same direction. Net margin increased 77 cents when gross margin increased \$1.00. It is interesting to note that the extremely small coefficient on X_6 of -0.0039 proved to be significant at the 0.3 level. Even though it was observed that a decrease of \$100 in inventory level per unit was associated with an increase of only \$0.39 in net margin per unit, the standard deviation was so small that this relationship might exist. Contrasting this with the results for X_7 , one finds that an average increase of 1 percent in ITO was associated with a 0.32 percent increase in net margin. However, the standard deviation of 2.68 for this relationship indicates a strong probability that the true population coefficient is zero. It is more likely that the sample coefficient should be considered a chance event. It should be noted also that, although it proved necessary to have very large changes in inventory level to discover noticeable change in net margin, it is quite possible to have large changes in the level of inventory per unit sold. The observations used for this variable are shown in Table 8. The average for the 18 firms was \$147.36 per unit sold and the observations ranged from \$26.77 to \$523.05 per unit. The use of inventory control, particularly by firms above the average, could be a benefit.

Control of "human" expenses in the case of these small firms is a tool which can be directly used by management. However, the other variable of major importance, gross margin, is a result of several different variables. For this reason, a regression analysis using gross margin per unit as the dependent variable was also computed. According to the theory of the firm, "human" expense and net margin can have no effect upon the derivation of gross margin. These two variables were deleted from the analysis. The results of this second regression analysis are shown in Table 3.

Table 3.--Tire and Tube: Gross margin regression analysis results.

Variable	: Regression : coefficient :	Standard error :	Standardized coefficient :	Sample t-value
Y ₂ - Average price/unit	0.946	0.098	0.861	9.616 ¹
Y ₃ - Adjustment/unit	0.138	0.135	0.087	1.020
Y ₄ - Inventory level/unit	0.0015	0.002	0.085	0.782
Y ₅ - ITO (times per month)	-2.211	1.533	-0.165	-1.442 ²
.....
Constant term	= -18.359	: R = 0.958	: d.f. = 13	

¹Significant at 0.01 level.

²Significant at 0.2 level.

Source: Original Data.

A multiple correlation coefficient of 0.958 indicated that the list of independent variables was sufficiently complete for the purpose of explaining the variations in gross margin. The coefficients were standardized by dividing each by its standard error. The standardized coefficient of .861 on average price was largest and indicated that this variable served to explain most of the variation of gross margin. A coefficient of -0.165 on ITO was second and adjustments and inventory level had nearly identical standardized coefficients of .087 and .085 to "explain" the least amount of gross margin variation.

Again the regression coefficients were tested for significance. The sample t-value of 9.616 on average price was significant at the 0.01 level with the equation's 13 degrees of freedom. The sample t-value of -1.442 on ITO was significant at the 0.2 level. The remaining two variables had sample t-values allowing too great a margin for random error to be considered with any degree of certainty.

Expressing gross margin as Y₁ and incorporating the regression

coefficients yields the following equation:

$$Y_1 = -18.36 + 0.95Y_2 + 0.14Y_3 + 0.0015Y_4 - 2.21Y_5.$$

In the sample, a 1 percent increase in average price, Y_2 , was accompanied by a 0.95 percent increase in gross margin. Conversely, the two variables decreased by the same ratio. It was also observed that an increase of \$1.00 in adjustment per unit occurred simultaneously with an increase of \$0.14 in gross margin. A possible explanation of this phenomenon is that chance factors in the sampling procedure caused the occurrence of a positive relationship. Since the method of analysis is based upon a negative relation between average price and adjustments, the economic and mathematical expectation would be a negative relation between gross margin and adjustment. The sample t-value for adjustment of 1.020 is significant at the 0.4 level. On the average, this value in absolute terms could be expected to be ± 0.870 or greater 4 times out of 10 even though the true population coefficient was zero. The conclusion reached was that there exists only an indirect relationship between adjustment and gross margin through average price. The procedure cannot measure this type of interaction.

The coefficient of -2.21 on ITO indicates that an increase of 1 percent in ITO was observed to be accompanied by a decrease of 2.21 percent in gross margin. The standard error of this measurement was relatively large and would tend to instill a lesser degree of confidence in predictions made by use of the coefficient. However, the direction of the relationship was consistent with expectations. It may be that a reduction in ITO would occur with an increase in gross margin but the ratio of change could vary widely.

The regression analysis of the T & T department indicates that net margin per unit can be increased quite readily through decreases in the

amount of "human" expenses per unit sold. It can also be favorably influenced by increases in gross margin per unit but the manager cannot place as great a degree of confidence in the .77 to 1 ratio as can be placed upon the "human" expense coefficient of -1.27. In turn, the gross margin can be most favorably influenced by increases in average price. There is strong evidence that the gross margin would increase in the neighborhood of 95 cents for each one dollar increase in average price. The final conclusion is that gross margin may be increased via decreases in ITO but it is difficult to propose the magnitude of this relationship. Bearing these results in mind, the analysis will continue with an examination of the ratio and BEP results.

Ratio Analysis

Various ratios can be computed which assist in understanding the performance of a business. When computed on data from a cross section of firms, the intercomparison of various ratios combined with a knowledge of the interrelationships among many of the ratios can be helpful. The firm can observe how its several performance determining factors or variables compare with those of firms with more satisfactory performance and with those of less satisfactory performance. Greater usefulness can be obtained from observation of ratios over time within the same firm. A limitation of this study was time, so the ratios presented here were computed from cross-sectional data. Thus, the interpretation is limited to the extent that variations caused by noneconomic influences cannot be identified and must be assumed to exert a random influence.

Three classes of ratios will be considered in this section. The revenue ratios provide evidence of the existence of problems and aid in

delineation of problem areas. The expense ratios aid in locating problem sources in the expense area. The inventory ratios were used to analyze a specific and rather important implicit expense and to act as an additional source of evidence concerning difficulties in the sales area.

Revenue ratios: Gross margin is defined in this study as the difference between net sales and the cost of goods sold. Net sales are total sales corrected for various sales policies such as sales discounts and price adjustments for tire trade-ins. The cost of goods sold is the actual wholesale price to the local corrected for purchase discounts.

The average gross margin for the 18 firms was \$370.90 (Table 1) and represented 24.0 percent of average net sales (Table 4). Recall that Epard found average gross margin to be 15.2 percent of sales using 1963 data. This appears to be a substantial improvement. In reality the difference is caused by the fact of a departmental analysis being used. The results are not strictly comparable. It would be necessary to obtain information on all farm supply sales and include it to make the comparison.

A large range of percentage gross margins was found. Since all of the associations purchased tires and tubes from the same regional wholesaler, it is unlikely that this range was caused by excessive variation in the cost when it is expressed as a percentage of the selling price or on a cost per unit basis. The difference is more likely to be connected with pricing policies which cause differences in the selling price per unit. These differences should then be reflected in the ratio of gross margin per unit sold. Table 4 shows that this latter ratio ranged from \$2.84 to \$11.61. The comparison is exhibited by considering the associations numbered 2 and 4. Both had about the same net sales. However, the gross margin

Table 4.--Firm and Tube: Revenue ratios, gross and net margin expressed as a percent of net sales and on a per unit basis.

Rank	Firm	Units sold	Net sales	percent	Gross margin	percent	Net margin
Index	Number				per unit		per unit
Large volume							
1	3	183.4	\$5,056.04	30.1	\$ 8.30	20.1	\$ 5.55
2	5	136.4	3,800.34	30.8	8.60	9.8	2.74
3	14	94.6	2,349.59	19.9	4.95	4.5	1.12
4	2	86.2	2,214.52	24.9	6.42	-21.5	-5.54
5	4	93.5	2,158.94	12.3	2.84	-2.9	-0.67
6	10	77.9	1,776.21	15.4	3.53	12.2	2.80
7	17	64.2	1,666.08	21.1	5.50	9.2	2.41
8	6	71.5	1,654.83	16.6	3.86	-29.7	-6.88
9	16	54.3	1,404.88	25.5	6.60	3.9	1.01
Average of 9		95.8 ^a	2,453.49 ^a	23.8	6.08	4.0	1.04
Small volume							
1	12	51.5	1,243.48	19.1	4.64	7.0	1.69
2	18	45.2	1,190.37	26.7	7.05	1.6	0.43
3	8	27.9	778.93	31.0	8.66	-19.1	-5.34
4	1	24.5	657.72	23.6	6.33	9.3	2.50
5	11	17.3	543.06	37.0	11.61	-2.1	-0.67
6	15	18.1	472.23	26.1	6.82	-49.4	-12.89
7	9	13.6	333.70	11.5	2.84	-6.0	-1.49
8	7	10.0	267.99	27.8	7.44	-12.8	-3.44
9	13	8.1	214.97	18.6	4.96	7.4	1.99
Average of 9		24.0 ^a	633.61 ^a	25.1	6.62	-4.6	-1.22
Range: High		183.4	5,056.04	37.0	11.61	20.1	5.55
Low		8.1	214.97	11.5	2.84	-49.4	-12.89
Average of 18		59.9 ^a	1,543.55 ^a	24.0	6.19	2.3	0.58

^aSimple average.

Source: Original Data.

of \$6.42 per unit for firm 2 was associated with total gross margin being 24.9 percent of sales. This is contrasted by firm 4 with gross margin being \$2.84 per unit and 12.3 percent of sales.

The gross margin results seem to indicate that, on the average, the T & T department in the association has the possibility of contributing its share to the success of the business. The net margin ratios dispute the success of the contribution. Net margin in this study is the equivalent of the operating statement account called net operating savings by cooperatives. It is derived by deducting total expenses from gross margin on sales.

For the 18 associations, the average net margin was 2.3 percent of net sales or an average of 58 cents per unit sold. This indicates that an average of \$6.19 minus \$0.58 or \$5.61 per unit was needed to cover the expenses allocated to this department. The net margin of 2.3 percent of sales on the average may be compared with the 2.82 percent which Taylor found for 149 associations.

The range of net margin ratios gives the major indication of financial difficulties for some of the cooperatives. The range was from -49.4 to 20.1 percent of net sales or from a net loss of \$12.89 per unit to a net gain or savings of \$5.55 per unit. Of the 18 firms, 8 exhibited a net operating loss and 5 of these 8 had losses greater than 10 percent of net sales. One of the objectives of this study is to examine possible causes for this situation under the assumption that a knowledge of the cause is the first essential of a cure.

A question which should be answered is whether or not the gains or losses are linked with the sales volume of the cooperative. To investigate

this possibility, the associations were ranked from highest to lowest net sales. They were then separated into two equal groups, one to be called "large volume" and the other to be called "small volume." The revenue ratios according to these categories are shown in Table 4. The small volume average gross margin of 25.1 percent of sales compared favorably with the 23.8 percent average for large volume. This suggests that there is little difference in pricing policies between the volume groups. The difference between net margin of 4.0 percent on the average for large volume and net loss of 4.6 percent for small volume points out the idea that total expenses may not vary freely with sales. To the extent that this is correct, performance improvement can be attained by stricter expense control or by increasing volume. However, the problem of losses on sales is not exclusive to the small volume category. Table 4 shows that 3 of the 8 associations having net operating losses were classed in the large volume group. Comparison of the gross margin percentages of firm 17 with 21.1 and firm 6 with 16.6 percent implies that some of the difficulty may still be found in pricing policy.

A major benefit to be gained from the ratios of gross and net margin to sales and expressed on an amount per unit basis is to indicate where one needs to search for the problem. For example, if a firm found that it had a ratio of gross margin to sales falling near the average, say 23 percent, any difficulty could probably be located in the level of expenses. If the firm finds that its gross margin per unit is low relative to that of other cooperatives, this is strongly indicative of the need for a change in pricing policy. The other major benefit is that these ratios indicate whether or not a problem exists. A firm which found a net loss in dollar terms on its departmental operating statement would be assured of operating problems.

However, it is necessary to use ratios when the firm experiences a net savings since a net of \$10 on sales of \$100 is more favorable than a net of \$10 on sales of \$1000.

The average gross margin for the sample and those for the volume groups seemed to be sufficient. Also, the firms averaged a net margin of 2.3 percent of sales. Considering August as an average month, this percentage holds for a years performance also. It may or may not be the optimum for T & T department sales. However, it must be recalled that commercial banks normally pay 3 percent or more on pass book savings accounts. The indication is that a larger net return on the capital might well be expected. The difference between the percentage net margins of the large and small volume groups suggested economies of scale in sales of the product. If this is true to any marked extent, the small volume firms must either increase sales volume or relinquish the activity to further the goal of economical performance. The net margin percentages of the two firms with the smallest T & T departments in the sample, firms 7 and 13, are evidence against economies of scale. Firm 7 experienced a net margin equal to 7.4 percent of its net sales and the percentage for firm 13 was 9.3. The revenue ratios suggest that pricing policies create difficulties for several of the firms while expense level causes difficulties for all firms on the average.

Expense ratios: The purpose of this section is to examine the sample findings regarding the level and constituents of expense, and to suggest the interpretation of various expense ratios.

Table 1 shows the total expenses allocated to the T & T department for each firm. For the 18 firms, the average monthly expenses totaled \$336.07 and ranged from \$23.99 to \$1,030.64. This represented an average

of 21.8 percent of net sales as shown in Table 5. Thus, the average association would need to realize a gross margin greater than 21.8 percent of sales in order to obtain a net operating margin or saving. The wide range of 3.1 to 75.5 percent of the expenses to sales ratio indicates the fact of large variability in the level of expenses. It may be quite possible then to raise or lower the average ratio. More stringent expense control measures could relieve much of the pressure for large gross margins. The ratios using various breakdowns of expenses assist in identifying the areas where control measures can be effective.

In this study, the category entitled "human" expenses includes social security payments, unemployment taxes, employee health plans, employee retirement plans, and any other similar benefits along with salaries and wages. Such items as employee gifts and bonuses as well as employ education fall within one of the items in the "other direct" expense category. The latter items occurred infrequently and might have removed some of the comparability among firms if they had been included in "human" expenses.

The category entitled "inventory" is, like depreciation, not a direct cost in the sense of being paid with cash or check. It is intended to exemplify the cost of having part of the firm's liquid assets in the less liquid form of inventories. For present purposes, the cost of shrinkage and obsolescence was ignored. Insurance was included in the direct item "insurance" and depreciation of the warehouse and station facilities was included in "depreciation." The only major cost remaining was the return forfeited on the money invested in tire and tube inventories. It was assumed that this money could earn at least 6 percent interest per year with readily available investment opportunities. Thus, the "inventory"

Table 5.--Fire and Tube: Expense groupings and total expenses expressed as percentages of net sales.

Rank Index	Firm Number	Net Sales :(dollars)	Expense group : human : other direct :		(percent of net sales) : depreciation : inventory :		Total
			Large volume				
1	3	\$5,056.04	1.2	2.5	2.8	3.4	9.9
2	5	3,800.34	10.8	6.5	2.0	1.7	21.0
3	14	2,349.59	10.1	1.7	0.9	1.9	15.4
4	2	2,214.52	21.4	13.0	10.1	2.0	46.5
5	4	2,158.94	10.5	2.4	0.9	1.4	15.2
6	10	1,776.21	1.6	0.6	0.3	0.6	3.1
7	17	1,666.08	4.4	4.2	2.1	1.1	11.8
8	6	1,654.83	32.8	6.5	3.0	4.1	46.4
9	16	1,404.88	11.9	4.4	2.3	3.0	21.6
Average of 9		2,453.49 ^a	10.1	4.5	2.8	2.3	19.7
			Small volume				
1	12	1,243.48	4.0	3.4	2.2	2.5	12.1
2	18	1,190.37	14.5	6.2	1.6	2.8	25.1
3	8	778.93	26.9	10.3	2.4	10.5	50.1
4	1	657.72	7.1	4.5	0.9	1.8	14.3
5	11	543.06	18.9	16.6	1.4	2.2	39.1
6	15	472.23	54.0	11.7	3.1	6.7	75.5
7	9	333.70	9.9	4.6	2.1	1.0	17.6
8	7	267.99	18.5	10.3	4.4	7.5	40.7
9	13	214.97	4.9	3.9	1.5	0.8	11.1
Average of 9		633.61 ^a	16.3	7.4	2.1	4.1	29.9
Range: High		5,056.04	54.0	16.6	10.1	10.5	75.5
Low		214.97	1.2	0.6	0.3	0.6	3.1
Average of 18		1,543.55 ^a	11.4	5.1	2.6	2.7	21.8

^aSimple average.

Source: Original Data.

expense per month is $1/12$ of that interest or 0.5 percent of the total inventory value. It is important to note that this is not a cost which can be entirely eliminated, for a firm engaged in retailing must maintain an inventory. However, it is possible for the inventory, and consequently the "inventory" expense, to be excessive relative to sales.

The "human" expenses averaged 11.4 percent of sales (Table 5). It would be difficult to say whether this was high or low compared to some optimum until it was considered in some light other than as a ratio to net sales. However, when one considers the upper limit of the range, it was evident that at least one firm experienced difficulty with this expense. The "human" expenses equal to more than half of the net sales (54.0 percent) was obviously higher than can be afforded by any retail business. This was particularly evident when contrasted with the "human" expenses equal to 1.2 percent of net sales for firm 3 which had the largest sales volume. It would appear that there was some room for a reduction in "human" expenses without serious damage to sales. If several of the firms could have reduced expenses for this input, then the average of 11.4 percent of sales was higher than optimum.

It can be noted from the same table that the average "inventory" expense of 2.7 percent of sales was larger than the average "depreciation" expense of 2.6 percent. Depreciation is generally regarded as a major expense item. Yet inventory expense seems seldom explicitly recognized. The inventory ratios of 7.5, 10.5, and 6.7 percent for firms 7, 8, and 15, respectively, are considerably higher than the average. It can be noted that firm 3 supported the largest sales volume in the sample with an inventory value which incurred an expense of only 3.4 percent of sales.

Firm 5, also with large volume, had an inventory expense of only 1.7 percent of its net sales. The indication is that, although nothing can be said objectively concerning lost sales due to insufficient inventory, several of the firms were maintaining inventories at an excessive level. The question of optimum inventory level will be dwelt with further in the section on inventory ratios.

If economies of scale regarding expenses exist for the tire retail business, the ratios according to volume group should provide evidence of this fact. The total expenses of the large volume group averaged 19.7 percent of net sales while those of the small volume group averaged 29.9 percent, a difference of about 10 percentage points. Six of these points occur in the "human" expense category. The large volume "human" expenses were 10.1 percent of sales and those of the small volume group averaged 16.3 percent. The relative indivisibility of labor in a small retail firm could be expected to produce economies of scale and apparently succeeded.

The "inventory" expense as a percent of sales could also be expected to be larger for small volume firms since each firm retails a large range of sizes and types of tires. This was the case with the small volume group averaging 4.1 percent and the large volume group incurring an average of 2.3 percent. The ratios of "other direct" expenses to sales also suggest that the expenses do not increase proportionately with sales. In that category, the small volume group averaged 7.4 percent compared to 4.5 percent for the large volume group. The range of the ratios for both volume groups also point to economies of scale as the small volume group generally ranged higher ratios than did the large volume group.

Ratios showing expenses are more meaningful when related to gross margin.

If expenses are greater than 100 percent of gross margin, then the association is incurring a net loss on operations. Table 6 shows the total expenses as a percentage of gross margin for each firm. The average ratio for the 18 firms was 90.6 percent. On the average, the 18 firms experienced a net operating saving of 9.4 (100 minus 90.6) percent of gross margin. It will be noted that firms 6 and 15 had ratios of 278.3 and 289.1 percent. The expenses allocated to the T & T department for these two firms were nearly three times as large as the respective gross margins from which they must be paid. It can be noted that the "human" expenses for these same two firms are about twice as large as the gross margins. The average ratio of "human" expenses to gross margin for the 18 firms was 47.3 percent. The lowest ratio of 4.1 percent was incurred by the firm with the highest sales volume. This points toward the idea that larger sales volume may cause more attention to be focused upon control of expense.

The large range of the ratios on gross margin is important. The fact that firm 10 was able to keep its total expenses down to 20.6 percent of gross margin implies that some serious difficulty existed in and was exhibited by the experience of firm 15 having its expenses equal to 289.1 percent of gross margin. It is perhaps unfair to expect a firm at one extreme to compare itself to the opposite extreme. Firm 18 is relatively close to the average of the 18 firms. Showing firm 15 first and firm 18 second, the ratios are: "human," 206.6 to 54.4 percent; "other direct," 44.3 to 22.8 percent; "depreciation," 12.1 to 6.0 percent; and "inventory," 25.9 to 10.6 percent; with the total being 289.1 to 93.8 percent. The gross margin obtained by firm 15 was equal to 26.1 percent of its net sales (Table 4), whereas the average of its volume group was 25.1 percent and

Table 6.--Tire and Tube: Expense groupings and total expenses expressed as percentages of gross margin.

Rank Index :	Firm Number :	Gross Margin (dollars)	Expense group		(percent of gross margin)	
			human :	other direct :	depreciation :	inventory :
						Total
			Large volume			
1	3	\$1,522.83	4.1	7.8	9.6	11.6
2	5	1,172.44	35.2	20.7	6.7	5.6
3	14	468.75	50.7	11.8	4.8	10.0
4	2	553.21	86.0	51.5	40.5	8.3
5	4	265.90	85.8	18.8	7.4	11.7
6	10	274.99	10.5	3.5	2.3	4.3
7	17	352.77	20.9	19.6	10.4	5.4
8	6	276.30	197.0	38.0	18.4	24.9
9	16	358.53	46.9	16.9	9.0	11.8
Average of 9			42.5	19.0	11.7	9.7
			Small volume			
1	12	238.73	21.2	17.3	11.6	13.5
2	18	318.78	54.4	22.8	6.0	10.6
3	8	241.62	86.8	32.9	8.0	34.0
4	1	155.30	30.2	18.5	4.2	7.7
5	11	201.00	51.3	44.5	4.0	6.0
6	15	123.46	206.6	44.3	12.1	25.9
7	9	38.60	85.6	38.6	18.7	9.5
8	7	74.65	66.7	36.7	15.8	26.9
9	13	40.02	26.8	20.3	8.1	4.7
Average of 9			65.0	29.3	8.2	16.4
Range: High			206.6	51.5	40.5	34.0
Low			4.1	3.5	2.3	4.3
Average of 18			47.3	21.2	11.0	11.1
Average of 18			370.99 ^a			90.6

^asimple average.
Source: Original Data.

the sample average was 24.0 percent. Therefore, firm 15 could be assured that its source of difficulty was to be found in its expense control measures. The only expense group for the firm which does not greatly exceed the sample average is depreciation. It may be that some of the items grouped under "other direct" expenses deserve more attention than others in that group. This can be determined by comparison with the averages in Table 7.

Prior to the investigation of the makeup of total expenses, it is worthwhile to note the volume group differences when expenses are expressed as a percent of gross margin. These ratios follow the same pattern as do the volume group average ratios of expenses to sales. The small volume ratios are generally larger than the large volume. It can be noted that the average total expenses of the large volume group were equal to 82.9 percent of gross margin for an average net saving of 17.1 percent of the average gross margin of \$582.86. In contrast, the small volume group averaged total expenses of 118.9 percent of gross margin. This was an average net loss on operations of 18.9 percent of the gross margin. Coupling this result with the fact that the small volume gross margin was 25.1 percent of net sales (Table 4) while that of the large volume group was 23.8 percent reinforces the argument that economies of scale are to be found in the activity.

Additional benefit is to be gained by closer examination of expenses. Table 7 expresses the major expense items as a percentage of total expenses. The 18 firms averaged slightly more than half of the expenses, 52.3 percent, in the form of payment for "human" services. "Depreciation," 12.1 percent, combined with "inventory," 12.3 percent, made up nearly a quarter, 24.4 percent, of the expenses. The remaining quarter constituted "other direct" expenses.

The range of the ratios for each item is quite large. However, there does not appear to be a significant degree of proportionality. Each firm has some ratios above average and some below average. For instance, firm 3 has the lowest ratio for "human" expenses at 12.4 percent of total expenses, and the highest ratio for "depreciation" and "inventory" at 29.0 and 35.0 percent, respectively. This raises the question of whether the expense control measures in this firm are considering the total picture or are concentrating only on the "human" expense item. Since the firms' expenses as percentages of net sales and gross margin were considerably below average, the results shown above may have been more nearly optimum than the averages. The results on "inventory" will be reconsidered in the section on inventory ratios.

Firm 15, with the greatest percentage net operating loss, had 7 items showing below average ratios and only 2 items, "human," and "rents and supplies," above the average ratios. In this case, the "human" expenses at 71.4 percent of total expenses could well be the major source of difficulty. If the total of the "human" expenses was decreased, the total expenses would also decrease and the proportionality would be changed. However, most of the ratios are sufficiently below the average to remain small even in this case. Since the regression analysis indicated that the "human" expenses had the greatest effect upon net margin, the manager could conclude that his problem solving activity had best be directed toward reducing "human" expenses.

There was not a great deal of difference between the volume groups regarding the makeup of expenses. The small volume average "human" expenses of 54.7 percent of total expenses was only slightly larger than the 51.3 percent average of the large volume group. The greatest difference was

found in depreciation expense where the large volume group averaged 14.2 percent compared to the 6.9 percent average of the small volume group. Interest expense, with the large volume group averaging 6.6 percent and the small volume group averaging 2.3 percent, had a noteworthy difference.

It has been indicated that the purpose of computing expense ratios was to locate sources of difficulty after the problem area had been determined. This is essentially a single firm concept and will be exemplified in the final section of the T & T department analysis. The section on expense ratios has provided averages to employ in the process of analysis by interfirm comparison. It has also provided additional evidence that some economies of scale are evident for this economic activity. The wide variation among ratios implies that expenses were subject to change and therefore were subject to control. The results also indicate that there was little difference in the makeup of expenses between the volume groups. The only salient differences were in the depreciation and interest expense items with the large volume average being proportionately greater for both items.

The "Inventory" expense has been seen to be an important expense item even though it is implicit. It is a real cost due to the loss of the use of working capital invested in inventory. Since some inventory is needed to support sales, the expense cannot be economically eliminated. However, it can easily become too large to be commensurate with the level of sales. The ratios in the following section are designed to investigate the determinants of this expense. Interpretation of the ratios also finds implications concerning sources of difficulty in the purchasing and sales area of retail performance.

Inventory ratios: Closely but inversely related to "inventory" expense is inventory turnover. It is a useful measure of the amount of inventory

held by the firm and is easily converted to a measure of the average number of days' supply on hand. Stated another way, this latter measurement is the number of days required to return the investment in inventory to working capital. Table 8 shows the average monthly inventory turnover ratio for each of the 18 firms and its derivation. For purposes of comparison, the inventory turnover (ITO) ratios are multiplied by 12 to show what the yearly figure would be if August were a "perfectly average" month. The ratio of inventory value per unit sold was used in the regression analysis. The observations for this variable are included in Table 8.

The monthly ITO is computed by dividing the number of units sold in August by the number of units in inventory. The 18 firms averaged sales of 59.9 units and inventory of 378.0 units. Thus, the average ITO in August was 0.23 times, which represents a yearly ITO of 2.79 times. In other words, the average firm could have supported its average sales for 131 days before it was completely depleted.

It has been mentioned that the associations make all merchandise purchases from the same wholesaler. This wholesaler offers four quantity discount periods each year. These periods are one month in duration and evenly spaced throughout the year. Thus, a local association could order in quantity lots every three months and, if it were willing to allow itself to be without inventory just prior to each delivery date, it could obtain an ITO of four times per year. However, the nature of the merchandise requires some extra stock on hand and this decreases ITO. If an association were to maintain additional stock equal to one month's stock at all times and reorder three months stock regularly, it could have an ITO of three times per year and retain the advantage of the purchase discounts. This could be used as a "rule of thumb" for inventory control.

Table 8.--Tire and Tube: Average inventory turnover and inventory value.

Rank Index	Firm Number	Units sold	Units in inventory	ITO (August)	ITO ^d (year)	Number of days supply	Inventory value per unit sold
Large volume							
1	3	183.4	1,630.5	.11	1.35	271	\$171.32
2	5	136.4	605.7	.23	2.70	135	85.57
3	14	94.6	432.8	.22	2.62	139	90.94
4	2	86.2	423.1	.20	2.44	149	94.58
5	4	93.5	286.7	.33	3.91	93	62.06
6	10	77.9	108.2	.72	8.64	42	26.77
7	17	64.1	174.4	.37	4.41	83	55.72
8	6	71.5	633.1	.11	1.36	269	170.63
9	16	54.3	390.6	.14	1.67	219	138.62
Average of 9		95.8	520.6	.25	3.00	122	105.62
Small volume							
1	12	51.5	296.1	.17	2.09	175	108.29
2	18	45.2	310.8	.15	1.75	209	132.50
3	8	27.9	757.3	.04	.44	827	523.05
4	1	24.5	110.3	.22	2.67	137	92.20
5	11	17.3	112.1	.15	1.85	197	127.98
6	15	18.1	295.2	.06	.74	496	314.28
7	9	13.6	33.8	.40	4.83	76	53.93
8	7	10.0	185.4	.05	.65	562	357.27
9	13	8.1	17.5	.46	5.54	66	46.88
Average of 9		24.0	235.4	.16	1.97	185	190.59
Range:	High	183.4	1,630.5	.72	8.64	827	523.05
	Low	8.1	17.5	.04	.44	42	26.77
Average of 18		59.9	378.0	.23	2.79	131	122.66

^dYearly ITO computed by multiplying ITO (August) by 12.

Source: Original Data.

Using the three times per year or 120-day supply as a standard, Table 8 shows that 13 of the 18 firms had ITO figures less than the standard for August. Of these 13 firms, four approached the standard. These four included firm 5 with 2.7 times, firm 14 with 2.62 times, and firm 2 with 2.44 times - all these firms being ranked high in the sales volume ranking.

Firm 10 exhibited the highest ITO rate with the equivalent of 8.64 times per year or 42 days supply. Reference to Tables 5 and 6 shows that the "inventory" expense for firm 10 amounted to 0.6 percent of its net sales or 4.3 percent of its gross margin and represented the low of the range in each set of ratios. On the other hand, the lowest ITO was exhibited by firm 8 and represented 0.44 times per year or 827 days' supply. Tables 5 and 6 show that the "inventory" expense ratios for this firm were the high of the range. The ratios were 10.5 percent of net sales and 34.0 percent of gross margin. This illustrates the inverse relationship between ITO and the level of "inventory" expense.

Proceeding under the assumption that August is an average month, it can be seen that a firm with an ITO of more than four times per year or less than 90 days must be purchasing some tires when the discount periods are not in effect. Thus, firm 10 with 42 days, firm 13 with 66 days, and firm 9 with 76 days must be relinquishing some purchase discounts. This might also be stated concerning firm 17 but is highly dependent upon the above assumption. The statements made above do not allow for the possibility of a "buffer" stock, e.g., the extra month's supply mentioned previously. Using the standard of three times per year or 120 days' supply, firm 17 and also firm 4 with 93 days' supply are added to the list of associations having mandatory purchases between discount periods. The question brought out here is whether or not this is detrimental to the financial performance

of the firm. The "rule of thumb" cannot answer this question.

It would be useful to have an economic gauge to determine whether or not a particular level of inventory as reflected in an ITO rate is the optimum or how the one in evidence varies from the optimum. This is an individual firm concept and cannot be answered with the limited available data. It must be answered by determining all of the relevant costs of holding inventory and contrasting them with the costs of not holding inventories. These latter costs are composed mainly of the costs of lost sales due to lack of time utilities, and loss of consumer good will.

It is possible to develop an economic gauge which will exhibit a minimum rate of ITO for the firm with the available data. This requires only a single policy decision on the part of the firm's management. A percentage rate of return on the investment in inventory must be set up as a goal. The rate of return on investment will be termed "RROI" and will be understood to refer only to the investment in inventory of tire and tube equivalents. For purposes of illustration, an RROI value of 30 percent per annum has been used.

The gauge is based on the fact that the RROI for a firm is equal to the average percentage markup multiplied by the average ITO. Having set a goal RROI of 30 percent, the firm can compute its average percentage markup by determining the difference between average price per unit and average cost per unit and dividing this difference by the average cost. Then it is only necessary to substitute the values into the equation

$$\frac{\text{average price} - \text{average cost}}{\text{average cost}} (\text{ITO}) = \text{RROI}$$

and solve for the necessary rate of ITO. It can be seen that any rate of ITO greater than that found in this manner will provide a RROI greater than

the goal. Using firm 3 as an example, it was found that the average price per unit was \$27.57 and the average cost was \$19.27. Then, using the 30 percent suggested above, one obtains:

$$\frac{27.57 - 19.27}{19.27} \text{ (ITO)} = .30$$

$$\frac{8.30}{19.27} \text{ (ITO)} = .30$$

$$(.431) \text{ (ITO)} = .30$$

$$\text{ITO} = \frac{.30}{.431}$$

$$\text{ITO} = .70 \text{ times per year.}$$

It is possible to compute a maximum number of units in inventory from this with the use of an accurate sales forecast. Continuing to work with firm 3, assume that the sales forecast for August of 1965 was 183.4 units, that which actually occurred. The ITO rate computed above is a yearly figure. When divided by 12, it yields an average monthly ITO of .06 times. Substituting in the formula

$$\text{ITO} = \frac{\text{number of units sold}}{\text{number of units in inventory}}$$

enables one to compute the maximum number of units in inventory which, with the given level of sales, will yield that monthly ITO. For firm 3, the maximum is 3,162.1 units when RROI = .30. For any inventory less than these, the ITO will be greater and the resulting RROI also greater.

Table 9 indicates these desired maxima and minima for the 18 firms using RROI equal to .30. It also includes a comparison with actual performance as shown in Table 8. For firm 3, the actual yearly ITO of 1.3 was somewhat larger than the .70 computed for RROI = .30. Thus, firm 3 had a RROI somewhat larger than .30. The result follows throughout the table.

Table 9.--Tire and Tube: Desired minimum ITO and maxium inventory level given current sales volume and example rates of return on investment.

Rank : Firm : Percent : Actual :	Yearly ITO :	Monthly ITO :	Units in inventory						
Index : Number : Markup : RROI :	Actual : RROI=.30 :	Actual : RROI=.30 :	Actual : RROI=.30 :						
Large volume									
1	3	43.1	.58	1.35	.70	.11	.06	1,630.5	3,162.1
2	5	44.6	1.20	2.70	.67	.23	.06	605.7	2,435.7
3	14	24.9	.65	2.62	1.20	.22	.10	432.8	942.2
4	2	33.3	.81	2.44	.90	.20	.08	423.1	1,149.3
5	4	14.0	.55	3.91	2.14	.33	.18	286.7	524.7
6	10	18.3	1.58	8.64	1.64	.72	.14	108.2	570.7
7	17	26.9	1.19	4.41	1.12	.37	.09	174.4	688.5
8	6	20.0	.27	1.36	1.50	.11	.12	633.1	572.9
9	16	34.3	.57	1.67	.88	.14	.07	390.6	743.8
Average of 9		31.3	.81	3.00	.96	.25	.08	520.6	1,199.0
Small volume									
1	12	23.8	.50	2.09	1.26	.17	.11	296.1	490.0
2	18	36.6	.64	1.75	.82	.15	.07	310.8	661.8
3	8	44.9	.20	.44	.67	.04	.06	757.3	501.8
4	1	30.9	.82	2.67	.97	.22	.08	110.3	302.8
5	11	58.8	1.09	1.85	.51	.15	.04	112.1	407.1
6	15	35.4	.26	.74	.85	.06	.07	295.2	256.4
7	9	13.1	.63	4.83	2.29	.40	.19	33.8	71.2
8	7	38.6	.25	.65	.78	.05	.06	185.4	154.3
9	13	22.9	1.27	5.54	1.31	.46	.11	17.5	74.0
Average of 9		33.8	.58	1.97	.89	.16	.07	235.4	324.3
Range: High		58.8	1.58	8.64	2.29	.72	.19	1,630.5	3,162.1
Low		13.1	.20	.44	.51	.04	.04	17.5	71.2
Average of 18		31.8	.77	2.79	.94	.23	.08	378.0	762.1

The actual monthly ITO of .11 was larger than the minimum of .06 for RROI = .30. Similarly, the actual number of units in inventory, 1,630.5, is less than the maximum level of 3,162.1 units for RROI = .30. The second column in Table 9 shows that firm 3 experienced an actual RROI of 58 percent per annum.

The 18 firms averaged 31.8 percent markup and yearly ITO of 2.79. This represents an actual RROI of 77 percent on the average. Just as the 77 percent actual RROI is considerably greater than the 30 percent, the actual average ITO of 2.79 times per year is greater than the .94 times at RROI = .30 and the 378.0 average actual units in inventory is less than the 762.1 unit maximum at RROI = .30.

The large volume group averaged 520.6 units in inventory. This was about half as large as the maximum average of 1,199.0 units at RROI = .30. With average monthly sales of 95.8 units, the monthly ITO for this group was .25 which is, under our assumption of average month, equivalent to a yearly ITO of 3.00 times. This, with average markup of 31.3 percent, gives an actual RROI of 81 percent.

The small volume group maintained an average of 235.4 units in inventory compared with the 324.3 unit maximum at RROI = .30. The average number of units sold of 24.0 gave a monthly ITO of .16 and yearly average of 1.97. When combined with the markup of 33.8 percent, the actual RROI for small volume was 58 percent. Thus, the fact that the average markup for the small volume group was larger than the 31.3 percent averaged by the large volume group was not sufficient when combined with lower ITO to cause an average RROI as large as the 81 percent obtained by the large volume firms.

It can be noted that any decrease in the number of units in inventory, although less expensive to maintain and conducive to a larger RROI, can

lead to lost sales and thus to the loss of the markup. For instance, if firm 3 were to lose sales of several units whose combined cost was \$100, it would lose 43.1 percent of that or \$43.10 in gross margin. The cost of lost sales increases very rapidly. This shows the advantage of a larger sales volume. With this larger volume, it is economically possible to hold a larger and more varied inventory and thus decrease the possibility of lost sales.

Another point can be made with reference to Table 9. This gauge of performance is, of course, dependent upon the average selling price and buying cost, and thus upon the average unit gross margin of the firm. It is also dependent upon the choice of the RROI goal. Regarding the second determinant, three of the 18 firms; namely, firm 6 with actual RROI = 27 percent, firm 15 with 26 percent, and firm 7 with 25 percent, would have considered their performance satisfactory if their goal had been RROI = 20 percent. However, the picture would have been unsatisfactory with the goal of 30 percent. Firm 8 achieved the smallest actual RROI, 20 percent, of any firm in the sample.

The dependence on the selling price and buying price can be seen by contrasting firms 5 and 14. Firm 5 had an actual ITO of 2.70 times per year while that of firm 14 was 2.62 times. However, firm 5 had a sufficiently large unit gross margin to give a markup of 44.6 percent, while the gross margin obtained by firm 14 was much smaller and yielded a markup of 24.9 percent. The result was that firm 5 had an actual RROI of 120 percent on its investment in inventory, considerably above the average for all firms and the average of 81 percent for the large volume group. In contrast, firm 14, with nearly the same ITO rate, had an actual RROI of 65 percent.

It has been noted in the previous section that firm 3 exhibited the high of the range of "inventory" expense as a percent of total expense. The firm's ITO of .11 times per month was less than half as great as the .23 average of the 18. The actual RROI experienced by the firm was .58 whereas the sample average RROI was 77 percent per year. It would appear that a possibility exists for the firm to decrease its average inventory level, thereby increasing its ITO and actual RROI. The above implication assumes no variation in units sold, average price, or average cost over the relevant range of inventory level.

Thus, upon selecting a target RROI, preferably based on previous experience, a manager could obtain useful implications from inventory ratios. In general, the larger the percent markup, the more likely it is that the firm is losing potential sales due to a higher average price. However, the lower the percent markup, the more likely the firm is losing net savings due to lower gross margin. When the firm's ITO is above optimum, the opportunities for lost sales due to stockouts are enhanced. Conversely, when ITO is below optimum, it is likely that the firm's "inventory" expense is proportionately larger than would be economically required.

The data used in the study cannot indicate any magnitude of lost sales or locate the cause. Therefore it is not possible to determine an optimum. The need for a time series analysis of cooperative retail activity is evident.

The results of the section do provide averages which can be used in lieu of an optimum for interfirm comparison. The process has been used in several instances above and will be employed again in the concluding section of the T & T department analysis. Also, the frequent references

to preceding sections aid in exhibiting the interdependence of the various ratios. The following section again exhibits interdependence and relates the variables to total performance.

Break-Even Point Analysis

For purposes of convenience, the break-even point in this study will be denoted as "BEP." Various methods have been proposed to compute the BEP for a firm. The object is to determine what level of sales are necessary in order that the total revenue will equal total cost, i.e., the total profit or savings, as the case may be, is neither negative nor positive but is equal to zero. In this study, the total profit or savings figures were not considered. The net operating savings were used instead in order to limit the subject to sales performance. Also, the method of data collection did not allow for an accurate appraisal of the total costs in terms of those which are fixed and those which are variable in the usual sense of the terms. However, when a period of only one month is considered, it is extremely difficult for a small business to alter its total expenses. That is to say, the expenses associated with the T & T department in a given firm do not vary directly with sales volume within a relevant range. Thus, it was decided to use the total expenses in the same way as total fixed costs would be used. The cost which does vary directly with volume is the cost of purchasing the merchandise from the wholesaler. For this analysis, the average unit cost experienced by the firm was used as the variable cost per unit. This yields a linear relationship which could easily be plotted. Using the average selling price per unit for the firm also yields a linear relationship. Since it was felt that the total expenses were fixed in the

relevant range, they were assumed to be fixed over the entire range of possible sales for a firm.

Table 10 shows the derivation of two BEP's for each of the 18 T & T departments as well as the sales volume breakdown. The column "BEP" under "possible" shows what the zero savings point, in number of units sold, could have been if the firm had made no adjustments on tires. This is not to suggest that adjustments should not be made. The attempt is only to demonstrate the effects of such policy. Since the adjustments considered here are deductions from list price, the effect on performance is to cause a lower average selling price per unit and thus a lower gross margin per unit. The formula used here to compute the BEP is:

$$\text{BEP} = \frac{\text{total expenses}}{\text{gross margin per unit sold.}}$$

It can be seen that a decrease in the unit gross margin must mean an increase in the BEP.

The average BEP of the 18 firms was 54.29 units. However, there exists a large range, from 4.83 to 199.09 units. Some of the variability is probably connected with sales volume. The average BEP for the large volume group was 79.54 units, while that for the small volume group was 28.48 units. However, large variation remained within each group.

By the formula, it is apparent that differences in gross margin per unit also had significant effect on the relative size of the BEP. This is illustrated by firms 2, 4, and 6, with BEP's of 160.63, 115.65, and 199.09 units, respectively. After the effects of adjustments on gross margin are removed, firm 2 evidenced a 36 unit decrease in BEP. For firm 4, the decrease was 52 units, and firm 6 lost its position as the high of the 18 firms with a 111½ unit decrease in BEP. If there were no effects of

Table 10.--Tire and Tube: Actual and possible break-even point and derivation.

Rank Index	Firm Number	Average Price	Average Cost	Gross Margin	BEP (units)	Possible ^a			BEP (units)
						Average Price	Gross Margin	Average Price	
Large volume									
1	3	\$27.57	\$19.27	\$ 8.30	60.77	\$30.53	\$11.26		44.31
2	5	27.86	19.27	8.60	92.91	30.85	11.58		68.96
3	14	24.83	19.88	4.95	73.13	28.94	9.07		39.95
4	2	25.68	19.27	6.42	160.63	28.24	8.98		114.80
5	4	23.08	20.24	2.84	115.65	27.77	7.53		43.67
6	10	22.80	19.27	3.53	16.08	27.12	7.85		7.22
7	17	25.99	20.48	5.50	36.00	27.84	7.36		26.93
8	6	23.13	19.27	3.86	199.09	28.05	8.78		87.52
9	16	25.87	19.27	6.60	45.98	27.92	8.66		35.07
Average of 9		25.62	19.53	6.08	79.54	29.00	9.47		51.07
Small volume									
1	12	24.15	19.51	4.64	32.69	27.20	7.69		19.71
2	18	26.31	19.27	7.05	42.45	28.23	8.96		33.37
3	8	27.93	19.27	8.66	45.08	29.68	10.41		37.51
4	1	26.82	20.48	6.33	14.86	28.38	7.90		11.91
5	11	31.36	19.75	11.61	18.31	32.94	13.19		16.11
6	15	26.09	19.27	6.82	52.32	28.73	9.46		37.72
7	9	24.94	21.70	2.84	20.72	29.06	7.36		7.99
8	7	26.71	19.27	7.44	14.66	29.94	10.67		10.22
9	13	26.66	21.70	4.96	4.83	26.85	5.15		4.65
Average of 9		26.37	19.75	6.62	28.48	28.69	8.94		21.09
Range: High		31.36	21.70	11.61	199.09	32.94	13.19		114.80
Low		22.80	19.27	2.84	4.83	26.85	5.15		4.65
Average of 18		25.77	19.56	6.19	54.29	28.94	9.36		35.90
a possible average price (and resulting GM and BEP) computed by removing adjustments from average price. Source: Original Data.									

^aPossible average price (and resulting GM and BEP) computed by removing adjustments from average price.
Source: Original Data.

adjustments, the decreases would have been expected to be proportionate. The 18 firms averaged a possible BEP of 35.90 units, 18.39 units less than the actual average BEP. The range of possible BEP's was 4.65 to 114.8 units. The average gross margin increased from \$6.19 to \$9.36 per unit and the low range of gross margin increased from \$2.84 to \$5.15 per unit. These latter effects were due only to the removal of adjustment. Graphical presentation of the effects on BEP helps to clarify the issue.

Figure 2 illustrates the average and average possible BEP's for the 18 T & T departments. As has been stated, the average firm had zero net operating savings at 54.29 units. At this volume, total revenue and total cost were both equal to \$1,398.28, as illustrated on the vertical axis at point A. However, the average firm sold 59.9 units, point Y, on the horizontal axis. Then the distance OC on the vertical axis, \$1,543.62, represents the total revenue of the average firm. Similarly, the distance OE, F represents the total cost of \$1,508.31. The difference, total revenue minus total cost, of \$35.31 is the net operating savings for the average firm.

When the average adjustment for the 18 firms is removed from the picture, a possible BEP of 35.90 units is achieved. This is point X on Figure 2. A differently sloped total revenue curve now intersects the total cost curve a distance of OB above the horizontal axis. This possible BEP occurs at a revenue (or cost) of \$1,038.66. Proceeding along the new total revenue line, one finds the intersection with the perpendicular representing actual sales at a distance OD above the horizontal axis. This is a total revenue of \$1,733.51. The total cost curve and intersection remain the same. The possible net operating savings for the average firm is then \$225.20 as compared to the \$35.31 attained. Again, it is not suggested that a firm cease to

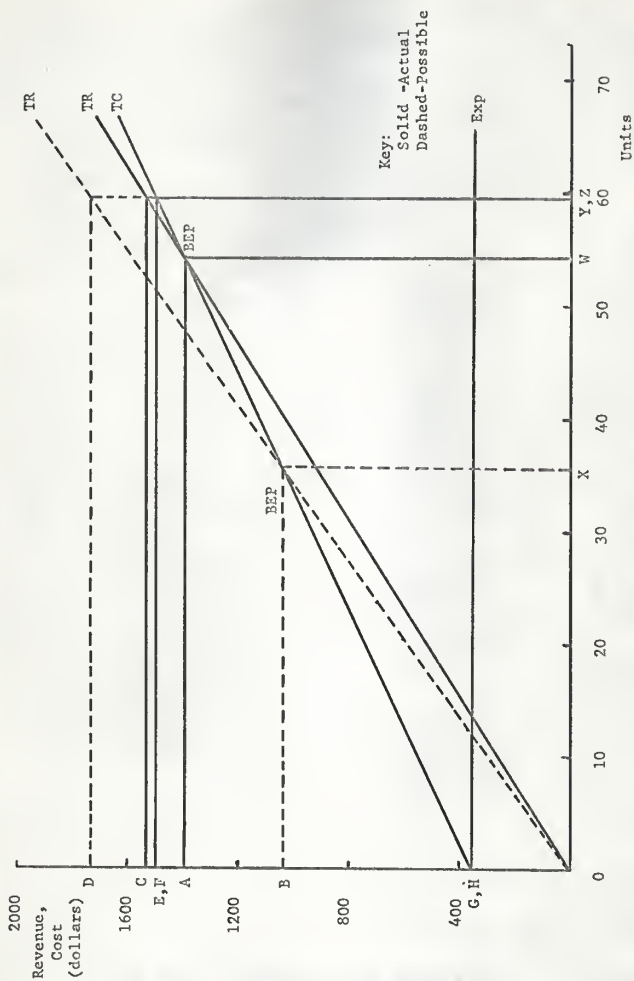


Figure 2.--Tire and Tube: Sample average actual and possible BEP.

adjust the price of its tires. It should be pointed out that, if the average firm were to reduce the size of its tire adjustments to the extent that the adjustment averaged \$1.00 less per tire, then its net operating savings would be increased by \$59.90 for the month of August. The chart illustrates how alterations in average price effect net margin through interaction with average cost and expenses. The latter two variables and unit sales are assumed constant in the illustration.

Figure 3 indicates a possible effect of variations in average cost and expenses by contrasting two firms showing marked differences in the two variables. Little difference existed between firm 13's average price of \$26.66 and the \$26.71 obtained by firm 7. The scale of the chart made this difference indistinguishable and therefore the firms appear to have identical total revenue lines. Firm 13 sold 8.1 units, point Y on the unit axis. The actual sales of 10.0 units for firm 7 are indicated by the perpendicular from point Z. Firm 13 broke even on sales at point W, 4.83 units, while firm 7 did not reach its BEP of 14.66 units represented by point X. The difference was due to differences in average cost and the level of expenses. In fact, the two variables exerted opposing influences.

The average cost of \$19.27 per unit expended by firm 7 caused it to have a total cost line of lesser slope than that determined by firm 13's average cost of \$21.70. The total cost lines thus tended to negate some of the difference caused by the variation in total expenses. Thus, the difference between a net savings and a substantial net loss is seen to be the level of expenses. The \$23.99 of expenses incurred by firm 13 is indicated by the expense line from point G while firm 7's expenses, point H, totaled \$109.14.

The overall performance of the firms can be seen on the vertical axis.

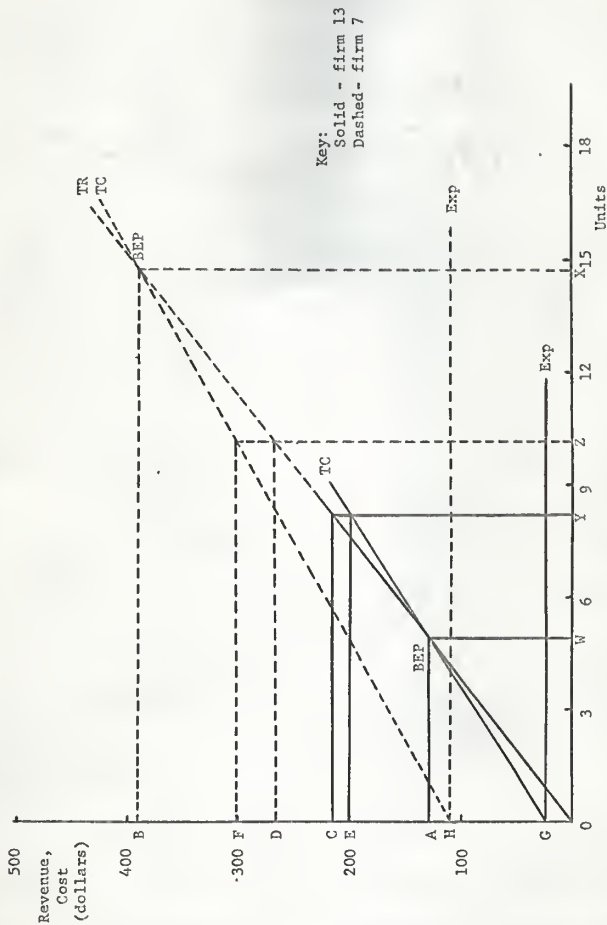


Figure 3.--Tire and Tube: Firms 13 and 7 - break-even charts illustrating effects of variation in expenses and average cost.

Firm 13 had total cost equal to total revenue at point A, \$128.77. The firm's actual revenue, \$215.95 at point C, less its total cost, \$199.76 at point E, equals a net savings on operations of \$16.19. Firm 7 needed \$391.57 in total revenue, point B, in order to reach the zero net savings point. The firm actually obtained total revenue of \$267.10, point D, and incurred total costs of \$301.84, point F. The difference of \$34.74 is the firm's net loss on sales of tires and tubes.

The above results reflect observations in the ratio analysis section. The average cost of \$21.70 per unit incurred by firm 13 was the high of the range of average cost observations. The firm did not obtain the discount on any of its wholesale purchases. Inventory maintained by the firm was small allowing a yearly ITO of 5.54 times, the second largest in the sample. The firm's "inventory" expense accounted for 7.9 percent of its total expense or 4.7 percent of its gross margin. The sample averages in those two categories were 12.3 percent and 11.1 percent respectively. A potential existed for lost sales due to insufficient inventory.

The average cost per unit of \$19.27 paid by firm 7 was the low of the range and reflected the fact that the firm was taking full advantage of purchase discounts. Connected with this purchasing policy was the firm's yearly ITO of .65 times, the next to lowest of the sample. The "inventory" expense for the firm amounted to 18.4 percent of total expenses and 26.9 percent of gross margin, both above the sample average.

The conclusion reached from the preceding comparison was that both firms were approaching extremes in performance areas where goals must be set as optimum rather than maximum or minimum. Firm 13, with a net operating saving, could have increased that saving with more sales. Firm 7 did not derive sufficient benefit from purchase discounts to offset the increased

"inventory" expense. The solution might well be for firm 13 to increase inventory and for firm 7 to decrease inventory.

The major benefit of BEP analysis is the graphical presentation of the interaction of the variables creating the total performance of the firm. The effect of altering the amount of adjustments was shown in Figure 2. It is equivalent to raising the average price and increasing gross margin per unit. Assuming that sales were not reduced, the effect is to lower the BEP and may constitute the difference between savings and loss. Figure 3 illustrates the effect of varying total expenses and indicates how average cost differences can interact with expenses to increase or decrease the effect of the expenses. With the assistance of a reliable forecast of sales and estimates of the variables, a manager could alter one or more of the variables in the department and visually observe the effects on total performance. It is only necessary to introduce all repercussions of a variable change. For example, an increase in inventory level might allow a lower average cost through the ability to obtain a discount on a greater portion in the inventory. It will also increase "inventory" expense and total expense. It may also increase sales by reducing stockouts. Recognition of the interaction of the variables is the major contribution of BEP analysis.

Example of Analysis

The two firms to be analysed were chosen in order to exhibit both the large volume and small volume groups. The particular firms were chosen because the T & T department sales amounted to approximately the same proportion of total station sales. Table 11 is a composite of the analytical results shown to be most important by regression analysis. It can be noted in the table that the department net sales, expressed as a percent of total

Table 11.--Tire and Tube: Ratios and results for firms 6 and 1 presented for analysis of total performance.

Item	Unit of account	Firm 6 : actual result	Average of : volume group : of 18	Firm 1 : actual result	Average of : volume group
1. Net sales	dollars	1,654.83	2,453.49	1,543.55	633.61
2. Net sales	% of station sales	8.3	a	11.8	a
3. Rank index					
4. Gross margin	dollars	276.30	583.93 ^b	370.99	159.04 ^b
5. Gross margin	% of net sales	16.6	23.8	24.0	25.1
6. Total expense	dollars	768.87	483.60 ^b	336.07	188.54 ^b
7. Total expense	% of net sales	46.4	19.7	21.8	29.9
8. Total expense	% of gross margin	278.3	82.9	90.6	118.9
9. Net margin	dollars	- 492.57	97.14 ^b	34.92	61.20
10. Net margin	% of net sales	- 29.7	4.0	2.26	- 4.6
11. Human expense	% of net sales	32.8	10.1	11.4	16.3
12. Inventory exp.	% of net sales	4.1	2.3	2.7	4.1
13. Human expense	% of gross margin	197.0	42.5	47.3	65.0
14. Inventory exp.	% of gross margin	24.9	9.7	11.1	16.4
15. Human expense	% of total expense	70.8	51.3	52.3	54.7
16. Inventory exp.	% of total expense	8.9	11.6	12.3	15.8
17. Level of sales	units	71.5	95.8	59.9	24.5
18. Level of invt.	units	633.1	520.6	378.0	235.4
19. ITO	times per month	.11	.25	.23	.16
20. ITO	times per year	1.36	3.00	2.79	1.97
21. Actual RROI	rate per year	.27	.81	.77	.58
22. Gross margin	dollars per unit	3.86	6.08	6.19	6.62
23. BEP	units	199.09	79.54	54.29	28.48
24. Possible GM	dollars per unit	8.78	9.47	9.36	8.94
25. Possible BEP	units	87.52	51.07	35.90	21.09

^aNot computed or tabled.^bComputed by multiplying average dollar sales of group by respective percentage.

Source: Tables 1 and 4 through 10.

station sales, was 8.3 percent for firm 6 and 7.9 percent for firm 1. Firm 6 was ranked eighth according to T & T department sales volume. Firm 1 was ranked fourth in the small volume group.

An analysis of firm 6 might proceed in this manner. The department sales volume of \$1,654.83 was somewhat smaller than the average of the large volume group which was \$2,453.49. However, it was larger than the average of \$1,543.55 in net sales obtained by the 18 firms. For purposes of this analysis, it will be assumed that the current monthly sales volume is given and is therefore not subject to policy decisions.

The firm can then observe that its gross margin of \$276.30 was smaller than the 18 firm average of \$370.99 and considerably less than the average of its volume group which was \$583.93. Additional clarity is introduced by inspection of the gross margin per unit, item 22 of Table 11. The firm grossed \$3.86 on each equivalent sold. Comparatively, its volume group averaged \$6.08 to apply toward average expenses and net savings. The 18 firms together averaged \$6.19 per unit.

The preceding paragraph suggests that a chief difficulty for this firm was to be found in the determinants of gross margin. The fact of an existing problem can be noted when one considers that the firm's expenses of \$768.87 for the month were 287.3 percent of gross margin. This caused a net loss on sales of \$492.57 or -29.7 percent of sales. Thus, the low gross margin contributed to the fact that the firm lost money.

The gross margin was not the sole cause of difficulty. The BEP of 199.09 units, item 23, was caused by the interaction of gross margin and expenses. Even without adjustments lowering average price, and therefore lowering gross margin, the BEP could be reduced only to 87.52 units and this remains larger than the actual sales of 71.5 units. The expenses would

remain larger than total gross margin.

Considering the expenses by the categories found important in the regression analysis, it can be seen that the "human" expense of 32.8 percent of net sales was nearly three times as large as the average for the sample of 11.4 percent. The "human" expense of 197.0 percent of gross margin indicates that either the gross margin must double or the "human" expense be halved in order to simply cover this one item. More improvement in one or both directions would be needed to realize a net savings. The "human" expense for this firm was 70.8 percent of total expenses whereas the 18 firms averaged 52.3 percent in this category.

The "inventory" expense for the firm required a fourth, 24.9 percent, of the gross margin. The volume group averaged 9.7 percent in this category and the 18 firms averaged 11.1 percent. This evidence indicated a comparatively large inventory level associated with the level of sales. The firm actually held 633.1 units in inventory for its sales of 71.5 units. The average for the volume group was 520.6 units in inventory and sales of 95.8 units. This phenomenon was also noted in the fact that firm 6 had an actual rate of return on investment in inventory of .27, while the average for the volume group was .81 and the 18 firms averaged .77. Firm 1 experienced an ITO of 1.36 times per year, while the 18 firms averaged 2.79 times.

Assuming that the objective for firm 6 was to experience a positive net savings, or at least break even, its course of action could have included one or more of the following suggestions. Adjustments could be made smaller than those currently being made in an effort to increase average price per unit and thus increase gross margin. Expenditures on labor might be surveyed to determine if some one or more employees could be better used in another department. A slightly more expensive method of inventory control, such as

perpetual inventory methods, might be employed to determine the usefulness of each type and size of tire and tube. Thus, extremely slow-moving items could be removed from orders and not replaced. This also allows the advantage of quantity discounts of fast moving items, which would be identified by stock-out conditions on a perpetual inventory. More strict controls on other expense items could also be helpful. The total effect of all actions described above would be to alter most of the analytical results described in Table 11. A record of these measuring devices over time would show the direction and magnitude of these changes and indicate the most successful policies.

Firm 1 can be analysed in the same manner but the conclusions are largely reversed. The operations of the firm were similar in size to the average of the small volume group. The firm sold 24.5 units for net sales of \$657.72. Its gross margin was 23.6 percent of net sales or \$155.30. The small volume group averaged 24.0 units for net sales of \$633.61. The average gross margin of \$159.04 was 25.1 percent of net sales. At this point the similarity ends. Deducting the firms total expenses of \$94.10 left a net margin (savings) of \$61.20, 9.3 percent of net sales. The total expenses of the volume group averaged \$188.54. This was 118.9 percent of the gross margin. The average net loss for the volume group was \$29.15 or -4.6 percent of net sales.

The firm had "human" expenses equal to 30.2 percent of its gross margin. The volume group averaged 65.0 percent in this ratio and the sample average was 47.3 percent. "Inventory" expense ratios for the firm followed the same pattern. The ratios of expense items as a percent of total expense were similar to both averages and indicated that all of the firm's expense items were proportionately less than average when expressed as a percent of

gross margin. It would have been a definite benefit for other firms to have copied the expense control procedures of firm 1.

The inventory ratios for the firm indicated the presence of more effective inventory control measures than were apparently employed by the volume group as a whole. There may have been room for improvement in the firm since its yearly ITO of 2.67 times was lower than the sample average of 2.79 times and the conditional standard of 3 times per year. However, the firms RROI of 82 percent per year indicates performance as effective as the large volume group which averaged RROI equal to 81 percent. In addition, the fact that the firm could reduce its BEP by less than 3 units if it had not made price adjustments indicated that the adjustments were not so large as to be likely to cause performance difficulties.

The results for firm 1 indicated that its T & T department operations were well above average and were satisfactory from an economic standpoint. The possibility existed for the firm to increase sales volume through increases in such expenditures as advertising. It might have been possible to attain larger sales volume with decreases in average price also. The feasibility of such results could be determined by time series analysis.

The section has helped to point out how an analysis of performance must consider many factors. The several performance determining factors must be considered in the light of their interactions upon each other and the resulting effects upon the total performance. No one set of ratios is sufficient in itself. However, an analysis guided by the full array of performance indicators can pinpoint the source or sources of each firm's difficulty and thus allow the remedial action to be most effective.

ANALYSIS OF BATTERY DEPARTMENT

To exhibit the relationships more clearly and more quickly, the order of analysis of this department will be altered from that of the T & T department. The strength of the relationships will be brought out first through the regression analysis. Then the relative size of the department and the results of ratio analysis will be presented, followed by break-even point analysis. The section will conclude with an over-all analysis of two of the 17 firms. One of the firms having a T & T department did not sell any batteries during the month of August. It is treated as if it was not engaged in the business of selling batteries.

Regression Analysis

A regression analysis was computed with the battery department observations of net margin per unit and the list of independent variables shown in Table 2. The results are exhibited in Table 12.

The standardized coefficient of X_5 indicates that the variation of "human" expense served to "explain" more of the variation of net margin than any other variable. As was the case for the T & T department, the relationship between the two variables was inverse. The gross margin variable was ranked second in ability to "explain" variation in net margin with a standardized coefficient of 0.467. The smallest coefficient, 0.009, indicated that the ITO "explained" the least amount of net margin variation of the six independent variables.

The statistical t-test was used to determine if the regression coefficients were significantly different from zero. The sample t-value of -8.863 for "human" expense was significant at the 0.01 level and beyond.

Table 12.--Battery: Net margin regression analysis results.

Variable	: Regression : coefficient	: Standard : error	: Standardized : coefficient	: Sample : t-value
X ₂ - Gross margin/unit	1.088	0.691	0.467	1.574 ²
X ₃ - Average price/unit	-0.039	0.676	-0.017	-0.058
X ₄ - Adjustment/unit	-0.125	0.446	-0.035	-0.281
X ₅ - "Human" expense/unit	-1.353	0.153	-0.896	-8.863 ¹
X ₆ - Inventory level/unit	-0.005	0.015	-0.065	-0.306
X ₇ - ITO (times per month)	0.332	7.802	0.009	0.043
.....				
Constant term = -0.60	:	R = 0.956	:	d.f. = 10

¹Significant at 0.01 level.

²Significant at 0.2 level.

Source: Original Data.

A large degree of confidence could be placed on the magnitude of the coefficient. Gross margin had a sample t-value of 1.574 which was significant at the 0.2 level with the equation's 10 degrees of freedom. There was only a small probability that the value would occur if the true population coefficient were zero. The remaining values were not significant at any acceptable level.

The variable interaction is clarified by expressing the coefficients in equation form.

$$X_1 = -0.60 + 1.088X_2 - .039X_3 - .125X_4 - 1.353X_5 - .005X_6 + .322X_7.$$

The equation had a multiple correlation coefficient of 0.956 indicating that the important explanatory variables had been included.

The regression coefficients in the above equation indicate the observed relationships between the respective variable and net margin. The gross margin, X₂, was observed to increase by one percent as net margin increased

by 1.088 percent. Net margin per unit decreased by \$1.353 for each \$1.00 increase in X_5 , "human" expense per unit. Similarly, a one percent increase in the number of times that inventory turned over per month was associated with a 0.332 percent increase in net margin.

The results were interpreted in this manner. The variation in the "human" expenses of the firms had the largest effect upon variations in net margin. The relationship was inverse with decreases in "human" expenses being associated with greater than proportionate increases in net margin. The disproportionality was probably due to a correlation of "human" expenses with some other expense items which were not included in the analysis. At any rate, the manager could be most assured of a favorable response of net margin if attention were focused upon efforts to decrease "human" expense per unit sold.

Again the relative indivisibility of the "human" resource must be admitted. The analysis indicated that net margin could also be increased by increasing gross margin. However, gross margin is a result of the interaction of other variables rather than a result of direct control. A regression analysis using gross margin as the dependent variable was performed to determine the controllable variables affecting gross margin. The results are shown in Table 13.

The standardized coefficients reflect the ability of variations in the independent variable to "explain" variations in gross margin. The average price, Y_2 , was ranked first. The other variables, in the order of decreasing explanatory value, were ITO, inventory level, and "explaining" the least amount of variation, the adjustment per unit.

The t-test indicated that the regression coefficient related to average

Table 13.--Battery: Gross margin regression analysis results.

Variable	: Regression : : coefficient :	Standard : error :	Standardized : coefficient :	Sample : t-value
Y ₂ - Average price/unit	0.868	0.123	0.884	7.063 ¹
Y ₃ - Adjustment/unit	-0.095	0.178	-0.062	-0.531
Y ₄ - Inventory level/unit	0.004	0.006	0.127	0.644
Y ₅ - ITO (times per month)	3.595	2.947	0.235	1.220 ²
.....				
Constant term = -16.677	:	R = 0.949	:	d.f. = 12

¹Significant at 0.01 level.

²Significant at 0.3 level.

Source: Original Data.

price was significantly different from zero at something less than the 0.01 level of significance. There was some assurance, but not firm conviction, that the coefficient related to ITO was significantly different from zero. The two remaining coefficients could be easily attained by chance. The multiple correlation coefficient of 0.949 provided confidence that the necessary variables had been included. The regression equation was:

$$Y_1 = -16.677 + 0.868Y_2 - 0.095Y_3 + 0.004Y_4 + 3.595Y_5.$$

In the sample, 0.868 percent increases in gross margin per unit were associated with one percent increases in average price per unit. Increases of one percent in ITO were found to occur simultaneously with increases of 3.595 percent in gross margin. As adjustment per unit decreased by \$1.00, gross margin was seen to increase by 9.5 cents. Extensive changes in inventory level were needed to appear in association with a noticeable change in gross margin.

The variations in average price served to best "explain" the variations in gross margin and a large degree of confidence could be placed in the

coefficient. Variations in ITO were associated with proportionately larger variations in gross margin but the coefficient had a greater likelihood of being due to chance than that of average price. The manager would prefer to use average price to affect gross margin.

The results in this section show that net margin is most affected by changes in "human" expense. Changes in gross margin are also somewhat important. In turn, gross margin is most dependent upon average price and may be affected by ITO. The regression coefficients indicate that net margin could be very favorably affected by relatively small decreases in "human" expense and increases in gross margin. Since gross margin increases appear to require average selling price increases, it may be more opportune to stress control of "human" expenses. Keeping these relationships in mind, the analysis can then proceed.

Accounting Results

The purpose of this section is to provide insight into the total dollar value of the various battery departments and indicate the relation to the over-all operating performance of the firms. Table 14 expresses a condensed operating statement for each firm. It also includes a percentage expression of the battery department sales related to the service station sales. It will be recalled that the figure representing expenses in this table is larger than that which would have appeared on an audit. It includes "inventory" expense. The net margin is in turn lower than an audit would show.

Net sales of the 17 firms ranged from \$36.50 to \$543.70 for this department and averaged \$170.69. For the average firm, this was 1.56 percent of total station sales. It may not be sufficiently large to warrant the

Table 14.--Battery: Dollar performance of firms in sample.

Firm Number	Net sales		Gross margin	Expenses	Net margin
	percenta	total			
1	1.2	\$ 39.55	\$ 10.35	\$ 13.59	\$- 3.24
2	3.6	148.83	33.00	96.22	-63.23
3	1.4	543.70	126.60	63.51	63.09
4	0.6	191.41	51.85	23.22	28.62
5	0.7	307.07	78.11	92.74	-14.63
6	1.3	398.26	67.55	110.83	-43.27
7	1.3	120.39	39.97	22.81	17.16
8	3.8	106.54	32.92	46.25	-13.33
9	0.1	36.50	7.30	5.50	1.80
10	0.1	43.03	14.50	1.61	12.89
11	1.8	96.21	14.44	32.72	-18.28
12	0.2	126.25	30.70	20.97	9.73
13	b	b	b	b	b
14	3.4	390.40	61.54	96.89	-35.35
15	5.0	94.88	26.57	61.74	-35.17
16	0.5	123.09	36.91	37.36	- 0.45
17	0.1	70.19	10.20	9.86	0.33
18	1.4	65.43	18.54	16.92	1.62
Range: High	5.0	543.70	126.60	110.83	63.09
Low	0.1	36.50	7.30	1.61	-63.23
Average of 17	1.56 ^c	170.69 ^c	38.89 ^c	44.28 ^c	- 5.39 ^c

^aNet sales as a percent of total station sales.

^bFirm number 13 had no battery sales in August. It was deleted from the analysis.

^cSimple average.

Source: Original Data.

status of a separate department. It is treated here as a department due to the fact that it is a product line somewhat distinctive from tires and tubes. The difference is that there seems to be much less seasonality with batteries.

The 17 firms averaged \$44.28 in expenses allocated to the battery department during August. The smallest expense was \$1.61 incurred by firm 10. Firm 6 was high with \$110.83. The gross margin ranged from \$7.30 to \$126.60 and averaged \$38.89 per firm while the net margin ranged from a loss of \$63.23 to a net savings of \$63.09 and averaged a net loss of \$5.39 on battery department sales.

Ratio Analysis

Revenue ratios: Such ratios as gross margin as a percent of net sales and net margin as a percent of net sales tend to remove variation due to sales volume and allow interfirm comparisons of performance. Table 15 sets forth these ratios using a volume separation like that used for the T & T department.

The average net margin was -3.7 percent of net sales. Of the 17 firms, 8 evidenced some net savings from the department and the remaining 9 had losses ranging from -0.3 to -42.4 percent of net sales. Firm 10 achieved the largest net savings with 29.9 percent. The department amounted to only 0.1 percent of that firm's total station sales, however. Firm 2 had the largest loss, amounting to 42.4 percent of its net sales. This loss occurred on 3.6 percent of its total station sales.

The gross margin on batteries ranged from 14.5 to 33.6 percent of sales with an average of 22.3 percent. Generally, the firms obtaining a net savings had gross margins of 20 percent or more. The exception was

Table 15.--Battery: Revenue ratios, gross and net margin expressed as a percent of net sales and on a per unit basis.

Rank	Firm	Units sold	Net sales	Gross margin		Net margin	
Index	Number			percent	per unit	percent	per unit
Large volume							
1	3	22.5	\$543.70	23.2	\$5.63	11.6	\$ 2.80
2	6	17.8	398.26	16.9	3.78	-10.8	- 2.43
3	14	17.7	390.40	15.7	3.47	- 9.0	- 1.99
4	5	12.3	307.07	25.4	6.32	- 4.7	- 1.18
5	4	7.4	191.41	27.0	7.04	14.5	3.89
6	2	6.2	148.83	22.1	5.28	-42.4	-10.12
7	12	5.1	126.25	24.3	6.02	7.7	1.91
8	16	4.6	123.09	29.9	7.94	- 0.3	- 0.10
9	7	4.3	120.39	33.2	9.22	14.2	3.96
Average of 9		10.9 ^a	261.04 ^a	22.0	5.36	- 2.1	- 0.39
Small volume							
1	8	4.0	106.54	30.8	8.29	-12.5	- 3.36
2	11	4.4	96.21	15.0	3.28	-18.9	- 4.14
3	15	3.7	94.88	27.9	7.21	-37.0	- 9.55
4	17	3.1	70.18	14.5	3.33	0.4	0.11
5	18	2.5	65.43	28.3	7.33	2.4	0.64
6	10	1.5	43.03	33.6	9.42	29.9	8.37
7	1	1.4	39.55	26.1	7.30	- 8.1	- 2.28
8	9	1.4	36.50	20.0	5.15	4.9	1.27
Average of 8		2.8 ^a	69.04 ^a	23.8	6.11	-10.1	- 2.43
Range: High		22.5	543.70	33.6	9.42	29.9	8.37
Low		1.4	36.50	14.5	3.28	-42.4	-10.12
Average of 17		7.1 ^a	170.69 ^a	22.3	5.50	- 3.7	- 0.76

^aSimple average.

Source: Original Data.

firm 17, which realized a small net saving of 0.4 percent of net sales while having the low of the range of gross margin with 14.5 percent. This suggests some factor or factors other than gross margin causing the difficulties.

Any differences created by sales volume should become evident when the firms are separated into volume groups. The 9 firms with higher net sales were grouped as "large volume" and the remaining 8 formed the "small volume" group. The large volume group averaged net sales of \$261.04, while the small volume group had average sales of \$69.04.

The large volume group averaged gross margin of 22.0 percent of sales. This figure was slightly larger for the small volume group at 23.8 percent. However, the small volume group averaged a net loss of 10.1 percent of sales, while the average loss for the large volume group amounted to 2.1 percent of sales. Both groups contained four firms having a net operating savings. There were some indications of differences due to sales volume. Further analysis is needed to substantiate, or reject, this view.

The major conclusion to be reached from the review of these ratios is that the majority of the firms in the sample were operating unfavorably in the sale of batteries. On the average, the gross margin seemed adequate. The ratios indicate that it is most probable that the difficulty occurred in the area between gross and net margin, the expense area. A second conclusion is that the small volume group seemed to experience more difficulty than the large volume group, particularly with the effort of controlling expenses. The possibility always exists for increasing gross margin. It was established by regression analysis that this procedure had a substantial effect on net margin in the study. However, it appears likely that the search for the major problem will be more fruitful if directed toward expenses.

Expense ratios: A glance again at Table 14 shows that the 17 firms averaged \$44.28 in expenses allocated to the battery department. A large range from \$1.61 to \$110.83 existed. Table 16 presents the total for each firm expressed as a percent of net sales. It also contains percentages using the various major categories which comprise the total.

The average firm of the 17 had expenses representing 25.9 percent of its net sales. The range was from 3.7 percent for firm 10 to 65.0 percent for firm 15. The firm with the largest dollar expenses, \$110.83, had sufficient sales so that this figure represented 27.8 percent of them, slightly greater than the average firm. It will be recalled, however, that the average firm experienced a net loss on sales. Firm 6, with this high total expense of \$110.83, was not an exception. These expenses amounted to 164.0 percent of gross margin as shown in Table 17, or a net operating loss equal to 64.0 percent of gross margin. The above results suggest a problem involved in both expenses and gross margin.

The 17 firms had "human" expenses ranging from 1.4 to 50.1 percent of net sales and averaging 14.5 percent. The range of depreciation expense was from 0.3 to 14.3 percent of sales and averaged 3.1 percent. "Inventory" expense averaged 2.1 percent and was generally limited with a range of 0.6 to 5.1 percent of net sales. The "other direct" expenses averaged 6.1 percent of sales.

Expenses expressed as a percent of gross margin indicate more vividly the actual performance of a firm since the difference between the actual result and 100 percent is the net savings or loss as a percent of gross margin. Table 17 shows that total expenses averaged 113.9 percent of gross margin and ranged from 11.1 to 291.6 percent. When separated according to

Table 16.--Battery: Expense groupings and total expenses expressed as percentages of net sales.

Rank Index	Firm Number	Net Sales (dollars)	Expense group			(percent of net sales)	
			human	other direct	depreciation	inventory	Total
			Large volume				
1	3	\$543.70	1.8	3.5	4.3	2.0	11.6
2	6	398.26	20.6	4.1	1.9	1.2	27.8
3	14	390.40	16.7	4.0	1.5	2.6	24.8
4	5	307.07	15.9	9.5	3.0	1.8	30.2
5	4	191.41	8.0	2.0	0.6	1.5	12.1
6	2	148.83	30.5	18.4	14.3	1.4	64.6
7	12	126.25	6.2	5.3	3.4	1.7	16.6
8	16	123.09	16.6	6.1	3.2	4.4	30.3
9	7	120.39	10.2	5.7	2.4	0.6	18.9
Average of 9		261.04 ^a	13.1	5.6	3.4	1.9	24.0
			Small volume				
1	8	106.54	26.0	10.0	2.3	5.1	43.4
2	11	96.21	16.7	14.8	1.2	1.3	34.0
3	15	94.88	50.1	10.9	2.9	1.1	65.0
4	17	70.18	4.4	4.2	2.2	3.2	14.0
5	18	65.43	13.8	5.9	1.5	4.6	25.8
6	10	43.03	1.4	0.6	0.3	1.4	3.7
7	1	39.55	17.9	11.0	2.4	3.0	34.3
8	9	36.50	7.3	3.4	1.5	2.8	15.0
Average of 8		69.04 ^a	20.6	8.6	2.0	2.9	34.1
Range: High		543.70	50.1	18.4	14.3	5.1	65.0
Low		36.50	1.4	0.6	0.3	0.6	3.7
Average of 17		170.69 ^a	14.5	6.1	3.1	2.1	25.9

^aSimple average.

Source: Original Data.

Table 17.--Battery: Expense groupings and total expenses expressed as percentages of gross margin.

Rank : Index :	Firm : Number :	Gross Margin : (dollars)	Expense group : human : other direct : depreciation : inventory :	(percent of gross margin)	Total
			Large volume		
1	3	\$126.60	7.9	18.5	8.7
2	6	67.55	122.0	15.0	7.1
3	14	61.54	106.1	23.5	11.4
4	5	78.11	62.6	24.8	16.5
5	4	51.85	29.9	36.7	7.4
6	2	33.00	137.8	6.6	2.6
7	12	30.70	82.5	64.8	5.8
8	16	36.91	21.0	6.5	6.5
9	7	39.97	14.1	7.4	7.4
			20.0	10.7	14.9
			30.8	7.3	1.9
Average of 9		58.47 ^a	58.6	15.3	8.6
			24.8		107.3
			Small volume		
1	8	32.92	84.2	7.7	16.7
2	11	14.44	111.7	8.7	9.3
3	15	26.57	179.2	10.5	4.1
4	17	10.20	30.6	15.2	22.3
5	18	18.54	48.8	5.4	16.5
6	10	14.50	4.3	1.0	4.4
7	1	10.35	68.6	9.5	11.5
8	9	7.30	41.7	7.9	14.4
			36.6		75.3
Average of 8		16.85 ^a	84.6	8.0	11.9
			35.2		139.7
Range: High		126.60	179.2	64.8	22.3
Low		7.30	4.3	1.0	1.9
Average of 17		38.89 ^a	63.9	13.8	9.3
			26.9		113.9

Simple average.

Source: Original Data.

categories, the total expense average was composed of average "human" expense of 63.9 percent of gross margin, average depreciation expense of 13.8 percent, average "inventory" expense of 9.3 percent, and the remaining "other direct" expense average of 26.9 percent. The range was narrowest on "inventory" expense with 1.9 to 22.3 percent. The largest range of 4.3 to 179.2 percent occurred in the "human" expense category.

It was previously noted that the expenses incurred by firm 6 were close to average when expressed as a percent of sales. These expenses were much larger than average when expressed as a percent of gross margin. They were equal to 164.0 percent. Examination of the firm's expense breakdown by categories shows that only one of the four groupings was greater than average. It was "human" expense at 122.0 percent of gross margin as compared to the average at 63.9 percent. This indicates that firm 6 needs policy action designed to decrease "human" expense as well as action to increase gross margin.

Some differences can be seen by separating the ratios according to sales volume. Tables 16 and 17 include this separation. The averages for the small volume group were, for the most part, larger than those of the large volume group. The exception was depreciation expense. This was the result which was expected since, in practice, the firms which were in the large volume group generally possessed more modern service station facilities.

The ratios of the "human," "other direct," and "inventory" expense categories, as well as the total expense ratios were larger for the small volume group. This held true when expressed as percentages of net sales and of gross margin. The implication is that there is evidence of some economies of scale for the battery department.

The range reaffirms the notion that there is room for improvement in expense categories for some of the associations. Of particular importance is the "human" expense category. The large volume group ranged from 7.9 to 137.8 percent of gross margin. The small volume range in this category was 4.3 to 179.2 percent of gross margin.

The "inventory" expense range of 1.9 to 16.5 percent of gross margin for large volume and of 4.1 to 22.3 percent for small volume suggests that this expense is fairly well controlled by the firms in the battery department. It might be more effectively reduced by increases in gross margin than by decreases in the expense. For the small volume group, the range of depreciation from 1.0 to 15.2 percent of gross margin also seems to imply fairly adequate control of this expense.

Table 18 shows various expense items as a percentage of total expenses. "Human" expenses averaged over half of total expense, 56.1 percent. The category ranged from 15.8 to 77.1 percent of total expenses. On the average, the depreciation expense at 12.1 percent was the next largest item with "inventory" third at 8.2 percent of total expenses. These three items combined then accounted for an average of 76.4 percent of total expenses. The "utilities" expense incurred by firm 11 and the "supplies" expense incurred by firm 8 were exceptionally large. The probable reason was some bookkeeping peculiarity practiced by the respective firms.

The range of "inventory" expense from 1.7 to 39.7 percent of total expenses suggests that it may be possible for inventory control practices to benefit some firms. There is a possibility for expense control practices to be effective also in depreciation; ranging from 3.8 to 36.9 percent; interest expense, ranging from 0.5 to 12.4 percent; and rents and supplies,

Table 18.--Battery: Individual expense items as a percentage of total expense.^a

Rank : Index : Firm : Number :	Human :	Int :	Taxes : & Ins :	Adver- tising :	Tele & util :	Rents & supp :	Depreci- ation :	Inven- tory :	other :	Total
Large volume										
1	3	15.8	11.3	1.7	1.9	1.2	1.8	36.9	17.4	12.0
2	6	74.3	3.6	3.0	0.6	1.1	1.8	6.9	4.3	4.4
3	14	67.4	2.9	3.2	1.1	2.7	5.2	6.3	10.5	0.7
4	5	52.7	10.9	5.1	0.5	2.1	8.7	10.1	6.2	3.7
5	4	66.6	b	4.7	4.9	3.4	0.2	5.7	12.9	1.6
6	2	47.2	8.9	5.9	1.4	4.1	5.0	22.2	2.2	3.1
7	12	37.7	12.4	5.7	1.3	3.1	0.7	20.7	14.7	7.7
8	16	54.9	5.1	4.9	1.6	2.2	1.5	10.6	10.7	4.5
9	7	54.0	5.8	7.7	1.3	3.7	5.6	12.7	3.3	5.9
Average of 9		54.6	6.8	4.2	1.3	2.4	4.1	14.2	8.0	4.4
Small volume										
1	8	59.9	0.5	2.1	0.6	0.7	17.3 ^d	5.5	11.8	1.6
2	11	49.2	1.9	2.5	0.5	34.4 ^c	0.4	3.8	4.1	3.2
3	15	77.1	b	3.4	0.3	2.0	10.3	4.5	1.7	0.7
4	17	31.6	5.6	10.7	0.5	2.3	4.9	15.7	23.0	5.7
5	18	53.4	b	4.6	5.5	0.8	3.3	5.9	18.0	8.5
6	10	38.5	1.9	3.1	0.6	1.8	0.7	8.6	39.7	5.1
7	1	52.2	4.1	4.8	0.4	3.0	3.3	7.2	8.7	16.3
8	9	48.5	8.0	2.8	1.6	2.4	2.2	10.5	19.0	5.0
Average of 8		60.6	1.3	3.5	0.9	7.3	8.6	5.8	8.5	3.6
Range: High		77.1	12.4	10.7	5.5	34.4	17.3	36.9	39.7	16.3
Low		15.8	0.5	1.7	0.3	0.7	0.2	3.8	1.7	0.7
Average of 17		56.1	5.4	4.1	1.2	3.6	5.2	12.1	8.2	4.2

^aExpenses in dollars listed in Table 14, p. 71.^bData not available.^dSupplies accounted for 17.1 percent.
Source: Original Data.

Utilities accounted for 33.7 percent.

ranging from 0.2 to 10.3 percent with firm 8 omitted. The item showing the widest range remains the "human" expenses.

The ratios examined above reinforce the regression analysis conclusion that the "human" expenses had a major effect on the variance of net margin. The category averaged 56.1 percent of total expense. It accounted for an average of 14.5 percent of net sales and 63.9 percent of gross margin. In all three ratios, the range over the 17 firms was wide and indicated that opportunity existed to adjust it considerably. However, data of this nature overlooks a character of this expense which creates difficulty. It is simply that the item deals with a factor which is highly indivisible for the small firm. In addition, the data yield little insight into the question of the efficiency of a unit of labor. The implication to be taken here is that, to the extent that it does not impair labor efficiency and is physically possible, the firm can only benefit from reducing the amount of "human" expense necessarily allocated to the department.

The analysis of expense ratios does indicate that certain other expenses, which are more divisible, would be responsive to control. These include the expenses exhibiting wide ranges such as depreciation in the large volume group, interest expense, rents and supplies, the "all other" item in Table 18, and, to a minor extent, the "inventory" expense.

It should be interesting to probe more deeply into an expense area which exhibits some degree of control. Since the "inventory" expense appears to meet this qualification, analysis of various other measures in inventory performance should provide favorable results.

Inventory ratios: The inventory turnover (ITO) in times per month and per year, the number of days stock in inventory, and the actual and desired

rates of return on investment (RROI) in inventory are the quantitative measures of inventory performance used in analysis of the T & T department. They are used again with the battery department. Table 19 presents some of these results set up by volume group. The 17 firms averaged sales of 7.1 battery equivalents for August. With an average of 35.2 units in stock, the ITO for August was .25. With the average month assumption, this is equivalent to an ITO of 2.97 times per year or 123 days' stock in inventory.

The large volume group averaged sales of 10.9 units, while the small volume group averaged 2.8 units. The large volume group averaged an inventory level of 49.1 units for an ITO in August of .26 or 3.09 times per year. They held an average of 118 days' supply. The small volume group supported sales with an average of 19.5 units in inventory for an August ITO of .20, which is the average of a yearly ITO of 2.44 times. This amounts to 150 days' supply. The reason behind this sales volume difference in ITO may be due somewhat to the fact that the batteries sold by the firms do not constitute a homogeneous product in reality. The wide selection of sizes and types could cause difficulty for attempts to adjust inventory levels to very low levels of sales. Opportunities can be envisaged for lost sales due to an "out of stock" condition on one or more particular batteries.

It can be seen that inventory control practices are not consistent over the sample. Firm 16, ranked eighth in the large volume group, and firm 7, ranked ninth, had nearly equal sales of 4.6 and 4.3 units, respectively. The inventory levels of these two firms caused them to experience the extremes of the large volume range. Firm 16 had an ITO for August of .09 or 1.04 times per year. This is equal to 350 days' supply, nearly a full year. Firm 7's August ITO of .58 on a yearly basis is 6.92 times or 53 days'

Table 19.--Battery: Average inventory turnover and inventory value.

Rank Index	Firm Number	Units sold	Units in inventory	ITO (August)	ITO ^a (year)	Number of days supply	Inventory value per unit sold
Large volume							
1	3	22.5	107.4	.21	2.51	145	\$ 88.50
2	6	17.8	46.6	.38	4.59	79	48.54
3	14	17.7	98.8	.18	2.15	169	103.49
4	5	12.3	56.0	.22	2.64	138	84.41
5	4	7.4	29.1	.25	3.04	120	74.52
6	2	6.2	20.8	.30	3.60	101	62.50
7	12	5.1	21.9	.23	2.79	131	80.52
8	16	4.6	53.4	.09	1.04	350	215.23
9	7	4.3	7.5	.58	6.92	53	32.34
Average of 9		10.9	49.1	.26	3.09	118	83.78
Small volume							
1	8	4.0	53.3	.08	.89	409	247.05
2	11	4.4	13.0	.34	4.06	90	54.78
3	15	3.7	10.5	.34	4.19	87	52.61
4	17	3.1	22.1	.14	1.67	219	139.57
5	18	2.5	29.6	.09	1.03	356	219.51
6	10	1.5	6.2	.25	2.97	123	76.63
7	1	1.4	11.5	.12	1.47	247	169.21
8	9	1.4	10.1	.14	1.67	219	148.61
Average of 8		2.8	19.5	.20	2.44	150	134.78
Range: High		22.5	107.4	.58	6.92	409	247.05
Low		1.4	6.2	.08	.89	53	32.34
Average of 17		7.1	35.2	.25	2.97	123	93.14

^aYearly ITO computed by multiplying ITO (August) by 12.^bComputed by dividing 365 by ITO (year).

Source: Original Data.

supply. It is difficult to say which of the two above is better but certainly neither is optimum. Other cases similar to the above can be found in the sample.

Another measure useful for managerial policy decisions is the RROI used with the T & T department. Table 20 shows that the average actual RROI for the sample was .87 with the large volume group averaging .90 and the small volume group averaging .74 in the battery department. Thus, the averages were considerably larger than the example rate of .30. By the same token, the actual ITO rates on the average were larger than the minimum desired rate for $RROI = .30$, and the average actual number of units in inventory was less than the maximum.

Over the sample, the average yearly ITO was 2.97, while the minimum for a rate of return of 30 percent was 1.02 times. On a monthly basis, the 17 firms averaged ITO of .25 times compared to a minimum of .08 for $RROI = .30$. Combining these with average unit sales, the average maximum inventory level at $RROI = .30$ is 83.7 units. The firms in the sample had an average of 35.2 units in inventory. The results for the volume groups were quantitatively different but similar in conclusion and proportionate to the difference seen in the actual RROI results. Only one firm, firm 17, experienced a RROI less than the example rate. The actual RROI for the firm was .28. The firm's actual yearly ITO of 1.67 times was therefore less than the 1.76 times minimum for $RROI = .30$ and its actual inventory level was 22.1 units compared to the 21.1 unit maximum at this rate. Again, it should be stressed that 30 percent rate of return is not to be considered as optimum but only as an example. Selection of the rate to use as a goal is a managerial policy decision.

Table 20.--Battery: Desired minimum ITO and maximum inventory level given current sales volume and example rates of return on investment.

Rank :	Firm :	Percent :	Actual :	Yearly ITO :	Monthly ITO :	Units in inventory :
Index :	Number :	Markup :	RROI :	Actual : RROI=.30 :	Actual : RROI=.30 :	Actual : RROI=.30 :
Large volume						
1	3	30.4	.76	2.51	.21	.08
2	6	20.4	.94	4.59	.38	.12
3	14	18.7	.40	2.15	.18	.13
4	5	34.1	.90	2.64	.22	.07
5	4	37.2	1.13	3.04	.25	.07
6	2	28.5	1.03	3.60	.30	.09
7	12	32.1	.90	2.79	.23	.08
8	16	42.8	.45	1.04	.09	.06
9	7	49.7	3.44	6.92	.58	.05
Average of 9		28.8	.90	3.09	.26	.09
Small volume						
1	8	44.7	.40	.89	.08	.06
2	11	17.7	.72	4.06	.34	.14
3	15	38.9	1.63	4.19	.34	.06
4	17	17.0	.28	1.67	.14	.15
5	18	39.5	.41	1.03	.09	.06
6	10	50.8	1.51	2.97	.25	.05
7	1	35.4	.52	1.47	.12	.07
8	9	25.0	.42	1.67	.14	.10
Average of 8		32.4	.74	2.44	.20	.08
Range: High		50.8	3.44	6.92	.58	.15
Low		17.0	.28	.89	.08	.05
Average of 17		29.5	.87	2.97	.25	.08

Source: Original Data.

A major reason for the performance shown by the RROI can be found in the percent markup. The average markup of the 17 firms was 29.5 percent of cost. The markup ranged from a low of 17.0 percent to a high of 50.8 percent over the sample. Markups of this size make it possible to realize substantial rates of return on investment in inventory, while having relatively low ITO rates.

The conclusion most evident from the analysis by inventory ratios is that the majority of the firms in the sample had successfully applied inventory control measures to the battery department. Possibly some of the firms could have effected improvements. Notable among these was firm 17 with RROI equal to .28 and firm 7 with RROI equal to 3.44. The latter rate reflects an extremely rapid ITO and the accompanying high probability of lost sales due to stock-outs.

The large average markup has an additional implication. Since markup percent reflects the size of the gross margin, this latter variable was also relatively large. The operating losses then on the average were not likely to be caused by lack of sufficient gross margin. The conclusion is that the inventory ratio analysis reinforces the previous conclusion that operating difficulties would have a larger probability of being due to excessive expenses.

The foregoing discussion has presented the results of analysis of the battery departments of the 17 firms using various ratios. The same data were used in a different form to present a graphical analysis of performance.

Break-Even Point Analysis

The method of BEP analysis used with the T & T department was also applied to the battery department. Table 21 exhibits the actual and possible

Table 21.--Battery: Actual and possible break-even point and derivation.

Rank Index	Firm Number	Average Price	Average Cost	Gross Margin	BEP (units)	Possible ^a		
						Average Price	Gross Margin	BEP (units)
Large volume								
1	3	\$24.17	\$18.54	\$5.63	11.28	\$26.28	\$ 7.74	8.20
2	6	22.33	18.54	3.78	29.26	25.75	7.21	15.37
3	14	22.01	18.54	3.47	27.92	25.75	7.21	13.43
4	5	24.86	18.54	6.32	14.66	28.99	10.45	8.87
5	4	25.99	18.95	7.04	3.29	27.64	8.69	2.67
6	2	23.82	18.54	5.28	18.21	26.07	7.53	12.77
7	12	24.77	18.75	6.02	3.48	25.75	7.00	2.99
8	16	26.48	18.54	7.94	4.70	28.63	10.09	3.70
9	7	27.76	18.54	9.22	2.47	29.09	10.55	2.16
Average of 9		23.94	18.55	5.36	10.19	26.72	8.14	6.71
Small volume								
1	8	26.83	18.54	8.29	5.57	28.02	9.48	4.88
2	11	21.82	18.54	3.28	9.98	25.75	7.21	4.53
3	15	25.75	18.54	7.21	8.56	25.75	7.21	8.56
4	17	22.90	19.57	3.33	2.96	23.75	6.18	1.59
5	18	25.87	18.54	7.33	2.30	25.75	7.21	2.34
6	10	27.96	18.54	9.42	0.17	30.17	11.63	0.13
7	1	27.90	20.60	7.30	1.86	25.75	5.15	2.63
8	9	25.75	20.60	5.15	1.06	25.75	5.15	1.06
Average of 8		25.06	18.94	6.11	3.85	26.46	7.52	3.13
Range: High		27.76	20.60	9.42	29.26	30.17	11.63	15.37
Low		21.82	18.54	3.33	0.17	25.75	5.15	0.13
Average of 17		24.15	18.62	5.50	8.05	26.68	8.02	5.52

^aPossible average price (and resulting GM and BEP) computed by removing adjustments from average price.
Source: Original Data.

BEP's for each firm. The average price obtained by the 17 firms was \$24.15 per unit. Without adjustments, this price could have been \$26.68. Each battery cost an average of \$18.62. The average gross margin actually received was \$5.50 per battery. It could have been \$8.02. The difference is reflected in the actual average BEP being 8.05 units when it could have been 5.52 units without adjustments.

In actual performance, the large volume group averaged a unit gross margin of \$5.36 and broke even at 10.19 units. Without adjustments, they could have obtained a gross margin of \$8.14 for a BEP of 6.71 units. The small volume group could have raised gross margin from the actual \$6.11 per unit to \$7.52 per unit without adjustments. This would have reduced the average BEP from the actual 3.85 units to the possible 3.13 units.

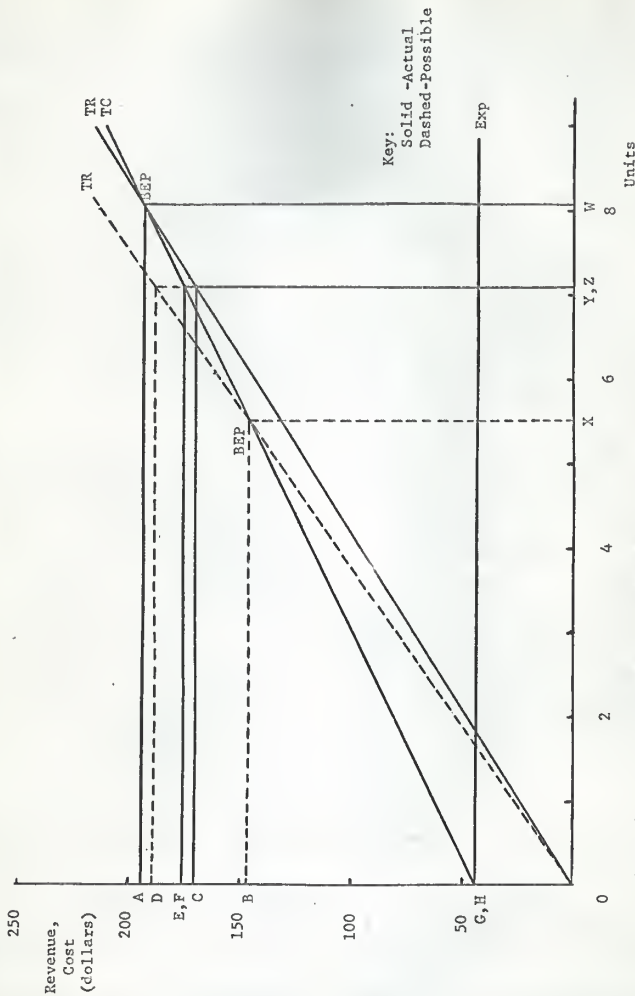
The gross margin per unit over the sample ranged from \$3.33 to \$9.42. It could have had a range from \$5.15 to \$11.63 per unit without adjustment. The range of actual BEP's was from 0.17 to 29.26 units. It could have ranged from 0.13 to 15.37 units. This decrease in width of the range as well as its general reduction provides the most important conclusion to be gained from analytical BEP analysis. It is that any reduction in the total of adjustments given by the firm, as long as it does not decrease sales, can only benefit the firm by allowing it to reach and pass the zero net margin point at a lower number of units sold.

The graph of the BEP has two major benefits to management. First, it focuses attention upon the interrelationships of the variables as they combine to make up the total. Second, it provides a visual impression of the effects that changes in a variable have on the firm's performance and indicates the mechanics of these effects.

Figure 4 is a graph of the average actual and possible BEP's of the 17 firms. It graphically presents the operating performance of the average battery department in the sample and compares it with the performance which could have existed without adjustments. The average firm, given the average gross margin and level of expenses, would reach the zero net margin point with a unit volume indicated by W on the figure. It represents 8.05 units sold. At this unit volume, the total revenue is equal to total cost at point A, \$194.41. The average firm actually sold 7.1 units, point Y,Z, and its total cost of \$176.48, point E,F, was greater than total revenue of \$171.47, point C, by \$5.01. This difference represents the average net operating loss in the department.

Without adjustments, the firms would have had a larger average price and larger gross margin. Graphically, this is represented by a total revenue curve with a steeper slope. It is shown as a dashed line in Figure 4. The intersection with the total cost curve occurs at X, 5.52 units, with the total revenue of \$147.27 indicated by point B. Had this been the case, the sales of 7.1 units would have produced a net margin equal to the difference between points D, \$189.43, and E,F, \$176.48, or \$12.95 in net savings. In this case, gross margin per unit changes as average price changes. However, the graphic presentation explicitly depicts only the change in average price. The related change in gross margin is implicit. The line parallel to the units axis with an intercept at G,H represents the fixed cost, or total expenses as assumed in this analysis, of \$44.28 for the average firm.

The BEP analysis has some value as a budgetary device. As an example, one can assume that the average firm predicted parameters for a future month. For simplicity, these predictions will agree with the data above,



i.e., sales of 7.1 units, expenses of \$44.28, and an average cost of \$18.62. From these, the total cost would be \$18.62 times 7.1 plus \$44.28 or \$176.48, point E,F in the figure. Then to break even, the firm must sell at an average price which will return \$176.48 on sales of 7.1 units or \$24.86 per unit. If the firm desired a net savings of \$10.00, then the 7.1 units must return a total of \$186.48 or \$26.26 per unit. To the extent that it is possible to vary the average cost, its necessary magnitude can be determined using estimates of unit sales, total expenses, and average selling price. Also, if it is determined by the manager that both average cost and average price are not subject to change, a maximum level of expenses can be determined for a given sales volume. To determine this, the manager need only multiply the gross margin per unit by the estimated number of units to be sold. Any level of expenses lower than the maximum so determined contributes to a positive net margin. In general, the manager can choose the controllable variable, estimate the remaining three variables, and solve for the required magnitude of the variable in question. Thus, the manager can establish a goal toward which he can direct the firm's activities.

The reduction in BEP shown in Figure 4 was caused by a change in the slope of the total revenue line. The two firm's charted in Figure 5 had an identical average price of \$25.75. Thus, the total revenue line applied to both firms. The purpose of the chart is to demonstrate the effects on the BEP of different levels of expense and changes in the average cost. It can be seen in Figure 5 that the level of expense incurred by firm 15 was the major reason behind the net loss on operations. The effect of the variation in average cost was to negate a part of the influence of expenses.

The results for firm 9 are indicated by the solid lines on the chart.

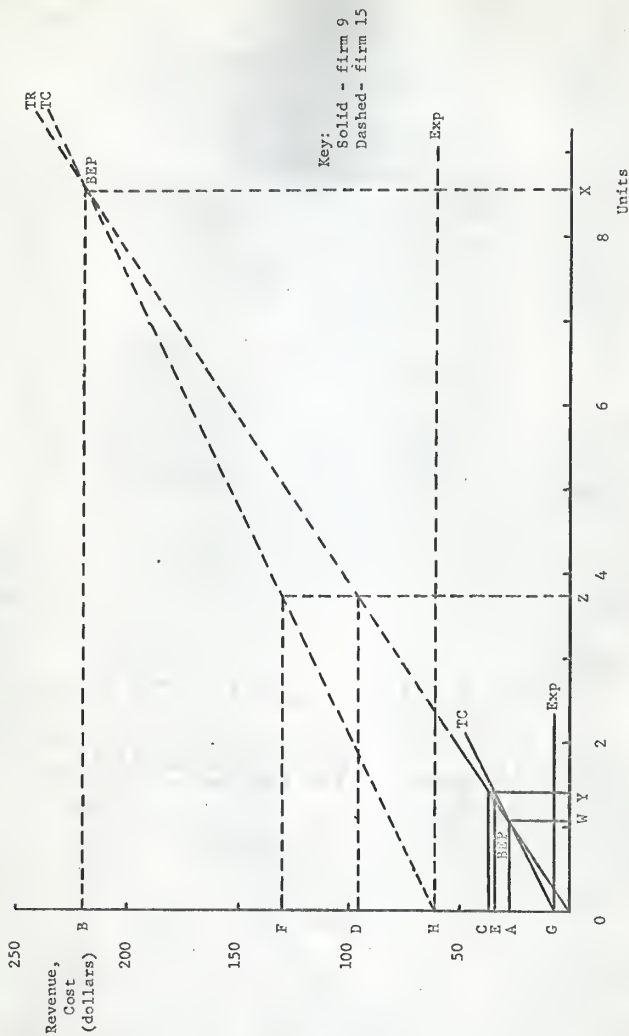


Figure 5.-Battery: Firms 9 and 15 - break-even charts illustrating effects of variation in expenses and average cost.

The firm experienced a net savings of \$1.71, the difference between points C and E, on sales of 1.4 units, point Y, for a total revenue of \$36.05 at point C. With total expense of \$5.50, point G, the firm reached the zero net savings point at points W, 1.06 units, and A, \$27.30. The average cost in this case was \$20.60, the high of the range for batteries.

Firm 15 took advantage of the purchase discounts offered by the regional wholesaler and obtained batteries at an average cost of \$18.54 per unit. This was the low of the range of average costs. When this variable was combined with total expense of \$61.74 at point H, the result was a BEP of 8.56 units, point X. The firm needed total revenue of \$220.42, point B, in order to meet total costs. If the firm had not received volume discounts on its purchases, the BEP would have occurred at a greater number of units sold. The firm actually sold 3.7 units, point Z, and suffered a net loss equal to the difference between total cost at point F of \$130.34 and total revenue of \$95.28, point D. Figure 5 graphically illustrates the regression analysis conclusion that "human" expense variations "explain" much of the variation in net margin.

It will be recalled that BEP analysis can be used for budgetary purposes. If firm 15 were to predict an average price of \$25.75, an average cost of \$18.54, and sales of 3.7 units as occurred in August of 1965, it could determine a maximum level of expense if its goal was to break even. The gross margin per unit of \$7.21 multiplied by sales of 3.7 units equals an expense maximum of \$26.68. The managerial goal would be to maintain total expense in the battery department at or below \$26.68 for the month.

Analysis of the battery department by BEP provides a pictorial presentation of the conclusion that the operating variables in a business

enterprise cannot be considered in isolation. The methods by which one or more variables in the system interact with and act on the other variables determine the final result. For instance, increasing gross margin per unit by increasing average price may decrease sales. Increasing sales will generally incur increased expenses. Decreasing "inventory" or "human" expenses, or any expense for that matter, may decrease sales due to insufficient or inefficient service. BEP analysis can indicate what the department's total performance was and, using estimates, predict the necessary magnitudes of the several variables in the future. It cannot, by itself, answer the question of the source of difficulty. When considered along with the other performance indicators used in the study, it can add weight to the total analysis by tending to approve or disprove the manager's hypothesis as to the trouble spot. This interrelationship will be exemplified in the following section.

Example of Analysis

Much of the value of the data presented rests in its usefulness to the individual firm. Proper use of comparison of the firm's results with averages, supplemented with a knowledge of the interrelationships of the variables, can lead to a correct analysis of performance, and can indicate the reason or reasons for unfavorable performance. Table 22 presents a composite of the measurements of the variables deemed most important by regression analysis. It also includes other useful measures which were not used in regression. Firms 7 and 11 were chosen for analysis because they experienced radically divergent results on nearly equal sales volume. Also, the department amounted to nearly the same percentage of total station sales

Table 22.--Battery: Ratios and results for firms 7 and 11 presented for analysis of total performance.

Item	Unit of account	Firm 7 : actual result	Average of : volume group : of 17	Firm 11 : actual result	Average of : volume group
1. Net sales	dollars	120.39	261.04	170.69	96.21
2. Net sales	% of station sales	1.3	a	1.56	1.8
3. Rank index	Large vol. #9	39.97	57.43 ^b	38.89	Small vol. #2
4. Gross margin	dollars	33.2	22.0	22.3	14.44
5. Gross margin	% of net sales				15.0
6. Total expense	dollars	22.81	62.65 ^b	44.28	32.72
7. Total expense	% of net sales	18.9	24.0	25.9	34.0
8. Total expense	% of gross margin	57.1	107.3	113.9	226.4
9. Net margin	dollars	17.16	5.48 ^b	5.39	18.28
10. Net margin	% of net sales	14.2	2.1	3.7	18.9
11. Human exp.	% of net sales	10.2	13.1	14.5	16.7
12. Inventory exp.	% of net sales	0.6	1.9	2.1	2.9
13. Human exp.	% of gross margin	30.8	58.6	63.9	111.7
14. Inventory exp.	% of gross margin	1.9	8.6	9.3	11.9
15. Human exp.	% of total expense	54.0	54.6	56.1	49.2
16. Inventory exp.	% of total expense	3.3	8.0	8.2	4.1
17. Level of sales	units	4.3	10.9	7.1	4.4
18. Level of invt.	units	7.5	49.1	35.2	13.0
19. ITO	times per month	.58	.26	.25	.34
20. ITO	times per year	6.92	3.09	2.97	4.06
21. Actual RR01	rate per year	3.44	.90	.87	.72
22. Gross margin	dollars per unit	9.22	5.36	5.50	3.28
23. BEP	units	2.47	10.19	8.05	9.98
24. Possible GM	dollars per unit	10.55	8.14	8.02	7.21
25. Possible BEP	units	2.16	6.71	5.52	4.53

^aNot computed or tabled.^bComputed by multiplying average dollar sales of group by respective percentage.

Source: Tables 14 through 21.

for both firms. The following paragraphs indicate how the manager of firm 7 would analyze the performance of his battery department.

The firm's net sales of \$120.39 were less than half of the average sales of the volume group and smaller than the \$170.69 average sales of the 17 firms. The department, comprising 1.3 percent of station sales, does not differ largely from the average battery department of the sample, which accounts for 1.56 percent of total station sales. The \$39.97 in gross margin obtained by the firm was about two thirds of the volume group average of \$57.43 and larger than the \$38.89 average of the sample. In percentage terms, the firm obtained gross margin equal to 33.2 percent of net sales compared to the volume group average of 22.0 percent and the sample average of 22.3 percent.

The firm's total expenses in dollar terms were half as large as the sample average and a third as large as those of the volume group. Expressing expenses as a percent of net sales removes differences due to the magnitude of sales. The firm's expenses were paid with 18.9 percent of its sales. On the average, the large volume group required 24.0 percent of sales for expenses. The average for the sample was 25.9 percent. Expenses are actually paid from gross margin. The firm paid 57.1 percent of its gross margin in expenses. The figure for the volume group was 107.3 percent with the sample average being 113.9 percent. The result was a net savings of \$17.16 for firm 7 which amounted to 14.2 percent of net sales. This is a worthwhile return by itself. It seems even better when one considers that both averages were losses, the volume group being -2.1 percent and the sample, -3.7 percent of net sales. From the standpoint of the normal accounting measures, the firm is doing well in this department.

No difficulties are noticeable in either gross margin or expenses, or so it appears.

If the manager with a concern for the interrelationships observed the figures listed above, he would have serious misgivings about the gross margin percentage. Further analysis shows the gross margin as \$9.22 per unit for the firm compared to a volume group average of \$5.36 and a sample average of \$5.50. A question is raised by these gross margin results. It may be that a high average price is retarding sales. The firm needs to investigate this possibility by lowering its average price and possibly increasing advertising to some extent. If sales increased, "human" expense and some others must increase also. The final result can be determined by computing the ratios over time.

The inventory ratios for firm 7 also appear out of place. The volume group and sample average ITO rates of 3.09 and 2.97 times per year, respectively, could be more optimum than the 6.92 times per year obtained by the firm. The firm's actual RROI in inventory of 344 percent greatly exceeds the volume group average of 90 percent and sample average of 87 percent per year. The possibility of lost sales due to insufficient inventory should be investigated.

The inventory ratios, along with the gross margin results, have an important implication for firm 7 in particular and for all firms. The accounting records of a firm can appear very satisfactory when the manager considers only such ratios as are normally prepared by an auditing firm. However, these ratios do not provide sufficient information for managerial decisions, particularly regarding sales goals. Firm 7 may be operating with less than full potential sales volume due to its inventory and pricing policies.

The performance of firm 11 was the opposite extreme. On sales of 4.4 units, the firm experienced total revenue of \$96.21. The small volume group, of which firm 11 was a member, averaged sales of 2.8 units for average total returns of \$69.04. Removal of the cost of goods sold left the firm with a total gross margin of \$14.44, which was 15.0 percent of its net sales. This amounted to \$3.28 per unit. The volume group averaged gross margin of \$16.43, 23.8 percent of sales or \$6.11 per unit. The sample averaged 22.3 percent of sales in gross margin or \$5.50 per unit. It appears that the pricing policy adopted by firm 11 has tended to reduce the unit gross margin to an exceedingly low level. The firm's possible gross margin per unit, item 24 in the table, of \$7.21 suggests that one source of difficulty is due to a policy of making large price adjustments on batteries. Removing these adjustments reduces the firm's BEP from 9.98 to 4.53 units. However, this cannot be the only source of trouble since the firm sold 4.4 units and would continue to operate at a loss.

The firm's expenses of \$32.72 accounted for 34.0 percent of its net sales or 226.4 percent of its gross margin. The volume group average was 34.1 percent of net sales but only 139.7 percent of average gross margin. Firm 11 experienced a net loss of \$18.28, which was 18.9 percent of its net sales. The average loss of the volume group was \$6.97, 10.1 percent of net sales. The firm had total expenses which were larger than average when expressed as percentages. Some difficulty existed in its expense control practices. It remains necessary to locate the source among the expenses.

Comparing the firm's "human" expenses to the average of the volume group shows: 16.7 compared to 20.6 percent when related to net sales; 111.7 compared to 84.6 percent when related to gross margin; and 49.2 compared to

60.6 when related to total expenses. The second one could be above average due to the low gross margin. It simply reflects the fact that the firm's total expenses are large. The ratios of "inventory" expense are all less than the volume group and sample averages. These results imply that the source of trouble was not centered in either "human" or "inventory" expense. It may be a general expense control problem or may be located in some other item. Reference to Table 18 shows that the expense of utilities incurred by the firm accounted for a third of its total expenses or 33.7 percent. This expense, combined with telephone expense, averaged 3.6 percent over the sample. The implication is that the utilities expense should be the prime target in attempts to reduce expenses. Effort could also be extended to reduce the dollar value of "human" expenses, since it constitutes a large portion of the total.

Review of the inventory ratios shows a yearly ITO for the firm of 4.06 times compared to the volume group average of 2.44 times. The volume group average RROI in inventory was 74 percent, while the firm obtained 72 percent per year. The ratios thus imply a fairly well controlled inventory.

In conclusion, the firm exhibits two primary areas for the immediate application of problem solving activity. The amount of adjustments should be reduced in order to increase dollar net sales and both dollar and unit gross margin. Along with this, the firm needs action designed to reduce the utilities expense. Secondary objectives could be the reduction of "human" and most other expenses.

SUMMARY AND CONCLUSIONS

The proportion of total cooperative sales provided by various "farm supply" items has increased rapidly in recent years in Kansas. Economical sales performance depends upon each item providing sufficient return to cover its share of the costs of operating the firm. An analysis of departments based on type of product is necessary to determine the actual return of each product or item and to determine reasons for inadequate returns.

The objectives of this study were: (1) to investigate the possibility of departmentalized analysis of supply sales given the current record keeping procedures of local cooperatives, and to determine if revisions are needed in these procedures; (2) to investigate the implications of inventory procedures and expense control on sales operations and performance, using (a) tires and tubes, and (b) batteries, as members of sample departments; (3) to determine if some other variables have an effect on the success of the department and to investigate the amount of their influence; (4) to suggest and apply methods of analyzing selling performance which are sufficiently general to be used in other farm supply departments.

Data were obtained for a random sample of 18 cooperatives taken from the 62 cooperative locations in Northeast Kansas which merchandize tires, tubes, and batteries. It was necessary to revert to sales tickets to obtain the information on sales by size and type of product. Inventory information was taken from year-end inventory counts. The expenses, with the exception of "inventory" expense, and the total sales of the business were taken from the accounting records. The performance for the month of August of 1965 was considered.

One product department consisted of tires and tubes. The 18 firms had an average net saving of \$35 on average net sales of \$1,540. The department accounted for an average of 11.8 percent of service station sales. Batteries were considered as a second product department. In this department the 18 firms averaged a net loss of \$5.40 on net sales of \$171, 1.56 percent of station sales. The net savings or loss for each department was less than that which would have appeared on a departmentalized annual audit. An imputed "inventory" expense was included. This expense represented the loss of potential interest payments on the money invested in inventory.

Several analytical tools were used with the two departments. Analysis by means of regression indicated that "human" expenses had the greatest effect upon net margin (net savings or loss). The size of the gross margin was also important for determination of the net margin. Gross margin was most dependent upon the average selling price and may have been slightly dependent upon the ITO rate.

Various ratios were computed for the firms in the sample. The revenue ratios, gross margin and net margin as percentages of net sales, constitute the beginning of analysis by ratios. For the individual firm, these ratios indicate the existence and proximity of operating difficulties. The 18 firms averaged gross margin of 24.0 percent and net margin of 2.3 percent of sales in the T & T department. Of the 18 departments, 8 experienced a net loss. The sample was divided in half according to net sales (volume) and averages were computed for the volume groups. The small volume group averaged gross margin of 25.1 percent and net margin of -4.6 percent of sales. The large volume average gross margin was 23.8 percent.

Its average net margin was 4.0 percent of sales. These ratios for the battery department were proportionately lower. The sample and both volume groups averaged net losses on operations in this department. In general, the revenue ratios indicated that the sample firms experienced greatest difficulty in the control of expenses. The ratios also suggested the existence of some economies of scale in the sales of these items.

Interfirm comparison of various expense ratios aids the firm in determining which expenses are out of line. Wide variability of these ratios suggested that expense control practices could be effective. The separation of the ratios by volume group added emphasis to the suggestion that there were economies of scale to be attained in both departments. For example, the small volume group averaged total expenses of 29.9 percent of net sales in the T & T department while the large volume group averaged 19.7 percent. In the battery department, the "human" expenses of the small volume group were an average of 84.6 percent of gross margin compared to a 58.6 percent average for the large volume group. The ratios indicated that the "inventory" expense was nearly as large as depreciation expense in the T & T department. The firms had proportionately lower "inventory" expenses in the battery department. The sample averages were "inventory" expense of 8.2 percent of total expenses in the battery department and 12.3 percent of total T & T department expenses. The latter ratios suggested more adequate control of battery inventory than of T & T inventory. This expense remains an important influence upon performance and needs explicit recognition by cooperative management.

Inventory ratios were computed to further investigate the inventory control practices of the firms. The 18 firms averaged an ITO rate equal to

2.79 times per year in the T & T departments. The sample average ITO for batteries was 2.97 times per year. Such averages can be used for interfirm comparison but cannot be regarded as necessarily optimum. An optimum rate would be attained at the point where the cost of maintaining inventory was equal to the cost of sales lost due to insufficient inventory. Time-series data would indicate these lost sales.

Analysis by break-even point indicates graphically the interaction of the variables in producing total performance. For example, the analysis indicated that, if the firms had not made price adjustments, three of the T & T departments and four of the battery departments would have experienced a net savings instead of a net loss. Changes in some other variables could have produced similar results. The BEP concept could also be employed as a budgetary device.

The study has shown that a useful analysis of sales performance can be performed using a firm's current records. The analysis could be improved by maintaining separate listings of sales in departmental accounts and by computing the ratios over time. The sample results indicated that the major problems in the two departments were caused by the excessive level of economies of scale in the "human" and "inventory" expenses. Inventory control practices seemed insufficient in many of the firms but it was not possible to make definite conclusions in this area without data concerning lost sales.

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ECONOMIC PERFORMANCE ANALYSIS OF KANSAS COOPERATIVE
FARM SUPPLY SALES EXEMPLIFIED BY TBA ITEMS

by

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ABSTRACT

The proportion of total cooperative sales provided by various "farm supply" items has increased rapidly in recent years in Kansas. Economical sales performance depends upon each item providing sufficient return to cover its share of the costs of operating the firm. An analysis of departments based on type of product is necessary to determine reasons for inadequate returns.

The objectives of this study were: (1) to investigate the possibility of departmentalized analysis of supply sales given the current record keeping procedures of local cooperatives, and to determine if revisions are needed in these procedures; (2) to investigate the implications of inventory procedures and expense control on sales operations and performance, using (a) tires and tubes, and (b) batteries, as members of sample departments; (3) to determine if some other variables have an effect on the success of the department and to investigate the amount of their influence; (4) to suggest and apply methods of analyzing selling performance which are sufficiently general to be used in other farm supply departments.

Data were obtained for a random sample of 18 cooperatives taken from the 62 cooperative locations in Northeast Kansas which merchandize tires, tubes, and batteries. The sales and inventory by size and type, and the expenses, for the month of August of 1965 were obtained from each firm. The 18 firms averaged net sales of \$1,540 in the tire and tube department and \$171 in the battery department for the month. An imputed "inventory" expense was included in the analysis. Thus, any net savings or loss observation was lower than the normal accounting figure by the amount of this expense.

Several analytical tools were used with the two departments. Analysis by means of regression indicated that "human" expenses had the greatest effect upon net margin (net savings or loss). The size of the gross margin was also important for determination of the net margin. Gross margin was most dependent upon the average selling price and may have been slightly dependent upon the inventory turnover rate.

Various ratios were computed for the firms in the sample. Interfirm comparability was increased by expressing various accounting figures as percentages and on an amount per unit sold basis. Gross and net margin as percentages of net sales indicated the existence and proximity of operating difficulties. Of the 18 firms, 8 experienced a net loss in the T & T department and 9 had battery department operating losses. The gross and net margin ratios indicated that some firms may have been pricing themselves out of the market. However, the major difficulties were located in the level of expenses.

The ratios of various expense items to sales and to gross margin indicated how each firm compared with other firms and the average. Wide variation in these ratios over the sample reinforced the hypothesis that the levels of various expense items were subject to change and control. Expense items as percentages of total expenses aided in determining which items were too large or too small compared to those of more successful firms.

Inventory ratios were computed to investigate the inventory control practices of the firms. An optimum inventory turnover rate could not be established in the absence of data concerning lost sales. The ratios provided benefit by reinforcing tentative conclusions concerning the

adequacy of a firm's gross margin and level of inventory.

The ratios were averaged for large and small volume groups, each consisting of half of the firms in the sample. Some economies of scale were apparent in both departments from comparison of the paired partial averages.

Analysis by break-even point indicates graphically the interaction of the variables in producing total performance. For example, the analysis indicated that, if the firms had not made price adjustments, three of the T & T departments and four of the battery departments would have experienced a net savings instead of a net loss. Changes in some other variables could have produced similar results. The BEP concept could also be employed as a budgetary device.

The study has shown that a useful analysis of sales performance can be performed using a firm's current records. The analysis could be improved by maintaining separate listings of sales in departmental accounts and by computing the ratios over time.